International Management Digest®

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THE McGRAW-HILL PUBLICATION OF WORLD BUSINESS INFORMATION

Edmond Leavey: Fewer telephones, more manufacturing, as IT&T expands around the world—p12

International Business Relationships—page 18

O.S.

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who gets the "hard" loans and who gets "soft"? President Eugene Black

LOOKING AHEAD

World Affairs

Accent on Cooperation

After months of behind-the-scenes debate, the "new look" in American foreign economic policy has taken shape (IMD—July p2). Its most important feature is the trend toward cooperative, multi-lateral efforts by the industrial countries.

Not everyone in the U.S.A. or abroad is convinced it will work. Conservatives worry about the emphasis on "soft" loans; others are concerned lest "regionalism"—in banks and development plans—be harmful to free-flowing trade.

Yet the direction seems firmly set. The result should be a major increase in capital for economic development (page 9).

And the Soviets?

Soviet foreign economic policy seems to stand at dead center. Some believe that the Russians may be cutting back in the area of development aid—though perhaps only temporarily.

For all Moscow's interest in India, it has done nothing to to help ease the present exchange crisis there (while the West and Japan jointly put up $350-million). Soviet-sponsored projects in the United Arab Republic are reported lagging.

Why? Business Week magazine suggests this possibility: that the U.S.S.R.'s Chinese partners object to large Soviet capital exports outside the Communist bloc. And there is no doubt that capital is needed urgently at home in Russia.

One sign is Khrushchev's abrupt change in energy policy. The U.S.S.R. needs more power quickly. So plans for huge hydropower installation have been shelved, and a drive launched to build steam power plants—which are more expensive, but can be completed much more quickly. There is also some evidence that Soviet atomic power programs are slowing.

More Money in the Bank

Members' quotas—and consequently lending power—of the World Bank and International Monetary Fund are almost certain to be raised (page 9).

It is simply a matter of arithmetic. In two years, the IMF has advanced $1,800-million, plus $900-million in outstanding stand-by credits, to hard pressed nations. That leaves a reserve of only $1,400-million in gold and hard currency reserves—not enough, the experts believe, to meet balance-of-payments problems that might arise from another Suez, or a widespread recession.

The World Bank has a different problem. Its reserves serve as a guarantee to the buyers of its bonds. And outstanding bonds are now approaching the level of the U.S.A.'s quota guarantee.

To be sure, cash is not needed now by either agency. The idea is to get the highest quotas "on the books" to meet future world liquidity problems.

Most quotas will probably be increased between 25% and 50%. But some well-off nations—Germany, and possibly Canada—may be asked to contribute more, while some smaller countries will stay the same.

Meanwhile, the World Bank is wrestling with the unique problems that would arise out of the plans for a "soft-loan" affiliate. How could it decide

Turn the page for more WORLD AFFAIRS

who gets the "hard" loans and who gets "soft"? President Eugene Black apparently intends to set up a single set of standards—and decide himself.

Patterns in Petroleum

The petroleum industry—and petroleum consumers—will be watching Cairo on November 1, as the Arab League sits down for an often-postponed Pan-Arab Oil Congress.

Of immediate concern will be the new Iraqi government's attitude. You can expect a strong statement about petroleum policy. So far, Baghdad says it will respect international obligations if they do not clash with the "interests of national economy."

Some observers fear these interests might include those of the United Arab Republic as well as Iraq. For there is no doubt that Nasser of U.A.R. (with no oil of his own) hopes to hammer out a common Arab petroleum policy—and press for higher royalties and prices and possibly structural changes in the industry.

The big question: Will Kuwait and Saudi Arabia cooperate?

"More money for our oil" seems to be a gathering battle cry everywhere. A Japanese contract in the Persian Gulf, Italian and U.S. deals in Iran, events in Latin America are weakening the old 50/50 profit-sharing agreements between the industry and producing countries. Even in Caracas, where 50/50 originated, there is a rising clamor for a bigger share.

Brazilian businessmen and government officials are studying Argentina's accumulating contracts and capital for oil development. Foreign financiers and oil companies say they will put up close to $1,000-million to speed development. Argentina, they say, can reach self-sufficiency in petroleum by 1961, and possibly an export surplus by 1964. But the foreigners will hold no concessions, and will not own the oil.

These arrangements make sense to many in Brazil, now struggling against a huge petroleum deficit. If they can calm the oil nationalists, a modified policy such as Argentina's may be forthcoming—soon.

Add it all up: the old order seems to be changing. But how the changes will affect world production and price remains to be seen.

The Trend of Business

Scylla & Charybdis: Inflationary forces in the U.S.A. are not as powerful now as all the talk would indicate; furthermore, the monetary authorities there seem determined not to let inflation psychology get the upper hand. Some Europeans, seeing a production slow-down at home, worry that too stiff anti-inflation measures could kill off the American business recovery in its cradle. So it goes: How to avoid inflation without foundering on deflation. The best bet: The U.S. recovery will not now generate an inflationary spiral, and Europe will not have a severe recession.

Argentina—for all its troubles—continues to attract manufacturing investment. Ford will spend $15-million on facilities for truck and tractor making; a French combine will work on the coal mines and a lubricant plant; Japanese want to get into shipbuilding and railroad equipment.

Company news: Britain's **Imperial Chemical Industries** enters the highly-competitive international retail film business via a large investment in Ilford Ltd. . . . Next year will see the giant Mitsui combine reappearing in Japan and round-the-world as the two largest postwar splinters—**Daiichi Bussan** and **Mitsui Bussan** trading companies—merge . . . **Outboard Marine Corp.** of the U.S.A., largest maker of marine outboard motors, power mowers, chain saws, etc., is in the midst of an international expansion. There's a new plant in Belgium, and plans for a new sales push throughout Europe, Latin America, and Asia.

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OCTOBER 1958
VOLUME 13 NUMBER 10

International Management Digest®

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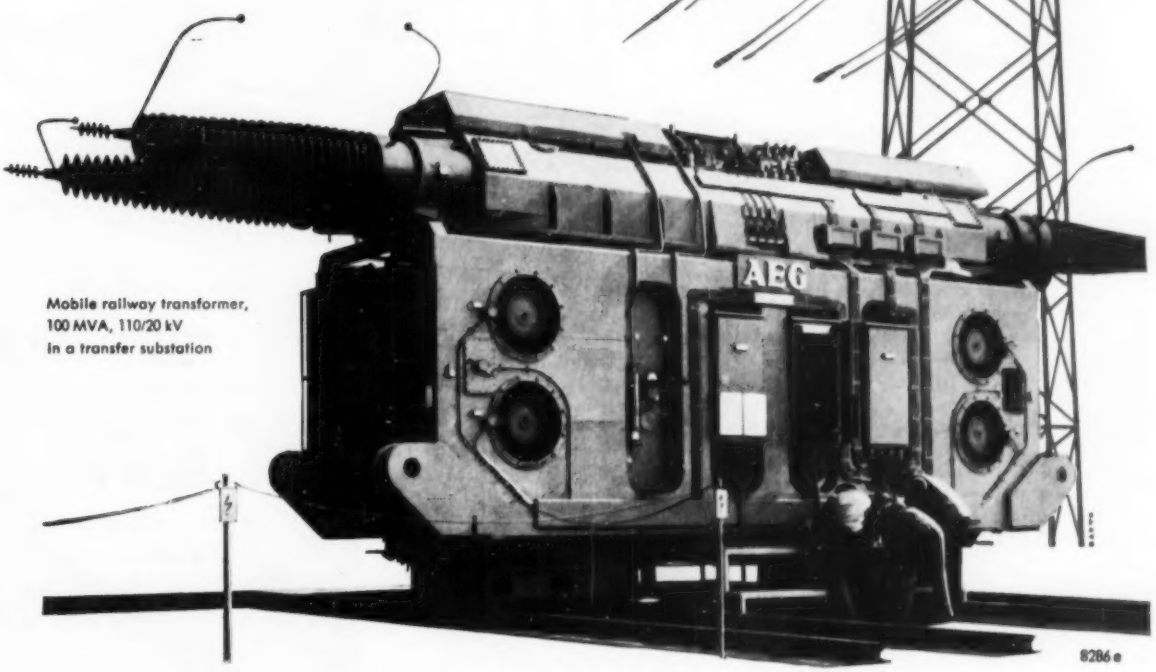

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Basic changes in American attitudes toward international economic problems may stimulate an important expansion in regional cooperation and planning, "soft-currency" loans, and the world's working capital.

New Directions for U.S. Policy

YOU CAN SEE IT in New Delhi, Tokyo, Rio de Janeiro, Washington, London, even Cairo: an increasing emphasis on regional economic development and international cooperation in financial matters. And at the heart of the matter is a basic change in the attitude of the United States government.

Most dramatic demonstration of the change was President Eisenhower's August proposals for a regional Arab development plan.

But clearer evidence—since the Middle East is clouded by political complications—is Washington's acceptance of the long-debated idea for an Inter-American development bank for Latin America, with direct U.S. participation. Plans for the bank will begin to take shape at a meeting in November.

Meanwhile, in New Delhi this month, members of the World Bank and International Monetary Fund are discussing plans to increase members' quotas. And American Treasury Secretary Anderson has announced Washington's support for higher quotas to increase the Fund's reserves, and for a new World Bank affiliate that would specialize in "soft-currency" loans.

Other signs of an international "pulling-together" on economic matters abound: Brazil's call for a 21-nation committee for Latin America along the lines of the Organization for European Economic Cooperation; India's creditors getting together to find ways to share financial support for India's stumbling Five Year Plan; the Japanese-American consultations on a proposed Southeast Asian development bank; U. S. participation in discussions of plans to stabilize commodities.

The significant point: In almost every case, the U.S.A. has shifted from opposition or indifference to multi-lateral development and lending schemes to qualified support. And the result may be a big expansion in "soft-currency," longer-term loans.

I. Accent on Regions

It is not hard to find the reasons. Russia's stepped-up economic offensive in the underdeveloped regions, the growth of Arab nationalism as a regional force, Latin American dissatisfaction with U.S. economic policies have all convinced Washington to try a fresh approach.

Regional economic development is nothing new in itself, of course. It has flourished in Europe. But the European programs were designed to rebuild an already powerful industrial plant and to expand its base. In contrast, the Middle East, Southeast Asia, and Latin America must concentrate on building the bare framework for development.

Obviously, a major part of the burden will have to be carried by U.S. government funds. But getting other nations to share the load is now the major objective of American planners.

A new world lending agency specializing in long-term, low-interest loans may well come into being before the establishment of the regional agencies in Latin America or the Middle East. Two legislative proposals were introduced into the American Congress this past session—one for an International Development Association, to be connected with the World Bank (it is the IDA that the Administration is supporting in New Delhi); the other an even more ambitious World Development Corporation, which would try to sell $15,000-million in non-voting shares to the public.

With the 1959 session of Congress, the world is almost certain to have some sort of new "soft-currency" agency. The initial capital will probably come out of the State Department's Development Loan Fund, which has a $400-million appropriation for next year, or surplus commodity sales.

II. Development Banks

Regional agencies in the Middle East, Latin America, and Southeast Asia would probably play a role similar to the proposed "soft-currency" bank—concentrating on projects that the conservative World Bank and IMF are reluctant to finance. The Southeast Asia bank, hardly beyond the "talk" stage, might well give way to the central world agency.

The Inter-American Bank, which has a good chance of being tried out, might accept surplus commodities as collateral; in other words, a Latin American nation could borrow a percentage—say 60% or 75%—of the market value of its stockpiled copper, lead and zinc, or perhaps even coffee.

But there is still a big debate over whether the agency will actually make "soft-currency" loans, or be a "hard-currency" agency. This and other details will be discussed at the November meeting of the Inter-American Economic & Social Council.

An Arab development bank has been on the agenda of the Arab League for some time. Since the League is now being revived, the Arab states may try to set up their own fund without help or cooperation from the United States, the

United Nations, or the World Bank. The main drawback is the reluctnace of the petroleum producing states—Iraq and Saudi Arabia, but mainly Kuwait—to commit their revenues to an uncertain future in an all-Arab bank, which would probably be under the influence of Colonel Nasser.

There is, however, strong and growing pressure among the Arabs for a regional fund. The most likely compromise: Enough Arab capital will be forthcoming to set up the fund—but far short of the potential capital resources.

III. Other Schemes

Meanwhile other regional cooperation schemes are being advanced—such as the Latin American common market idea, and international commodity control plans.

If the Latin American coffee producers can get together with the African growers, the prospects are bright that the U.S.A. would help to make the agreements effective. And the U.S.A. will be under renewed pressure to cooperate in stabilizing the non-ferrous metal markets.

Washington's new approach does not mean an end to its traditional single-nation aid policies—for military allies, "neutral" nations such as Yugoslavia or Indonesia, and hard-pressed countries such as Argentina and Lebanon. But the aid program has also taken a new direction: stressing loans, unusual credits, forgiveness of back debt, rather than outright grants. In the future, U.S. assistance is likely to run to longer term loans at lower interest rates, with more payments in local currency. ●

Better Protection for Patents, Trademarks?

Important changes to the international patent and trademark convention are being debated in Lisbon this month. Here is what to expect.

FAIR COMPETITION in international business affairs: This worthy cause brings delegates from 45 nations to Lisbon this month. And as a result of their deliberations, there will be some important changes in the International Agreements for the Protection of Industrial Property.

There will be new regulations that will affect businessmen everywhere. And there will be hot debate on some controversial amendments to trademark and patent accords. For example: proposals to issue patents for chemical products, and to change the "working" requirements for patents.

I. Areas of Agreement

But approval is expected on a number of amendments, including these protections for the international businessman:

—A minimum grace period of six months to file foreign patent applications, with rights retroactive to the original filing date; and a minimum grace period of six months to pay patent annuities, with revoked patents restored if failure to pay was accidental.

—Protection of designs for a minimum of five years.

—Protection for unique trademarks against infringement through using them in foreign translation or on products not made by the owner.

—Protection for trademarks even if the product is not available—if the mark is made known, as through advertising in magazines with an international circulation. And it should soon be possible to take out a trademark in a foreign country without first registering it at home.

It is well to know, however, that amendments to the Convention are by unanimous vote. Unanimous votes are predictable only because the proposed changes have been thoroughly discussed and agreed to by many of the delegates. This is done through a private group that calls itself The International Association for the Protection of Industrial Property—a body organized (in 1897) to provide a platform for open debate of problems in this field. The AIPPI meets every two years. Since the last amendment conference in 1934, there has been plenty of time for persuasion and compromise.

The unknown quantity at Lisbon is the "non-AIPPI" delegates who did not participate in these debates—in particular, delegates from the Eastern European Communist countries and from some underdeveloped countries.

II. Areas of Conflict

There is no easy way to reconcile the fundamental differences in viewpoint between the highly industrialized and less industrialized nations. There are always conflicts resulting from different legal systems, and differences in custom and traditions.

The conflicts, if there are any, will show up in the controversial amendments. One of the most controversial is the "working" requirements of patents. Under the present convention, if a patentee does nothing to exploit his property within three years, a govern-

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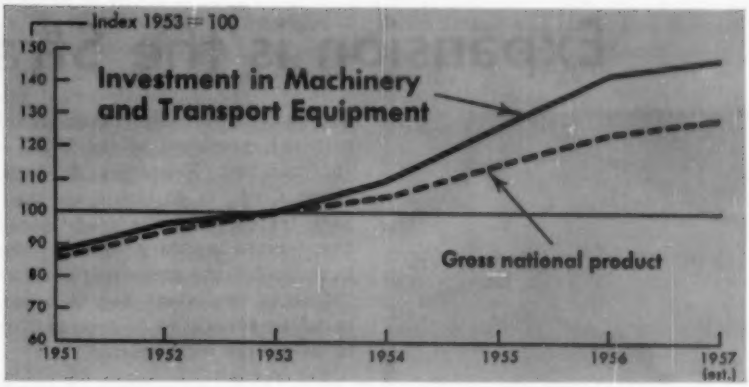
ment has the right to revoke the patent, or to require compulsory licensing. There are, of course, many reasons why a patent cannot be exploited in short notice—lack of capital, an inadequate market, the difficulty of finding a licensee. And it is almost impossible to begin "working" a patent in every country within three years.

Many patent laws permit the patentee to prove that he is taking reasonable strides toward exploiting his property before compulsory licensing is invoked. But in at least 14 nations, revocation may occur at the request of a third party if the patent is not worked, regardless of "nominal" working —such as advertising for licensees in trade journals.

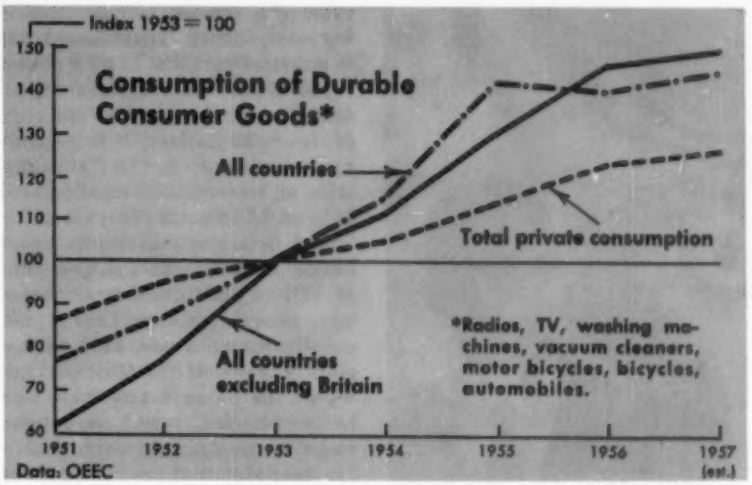
The amendment before the Lisbon meeting would allow a grace period of five years, and allow for compulsory licensing only—and then only if there is evidence of abuse, such as refusing to license the patent. Many delegates are against working requirements of any kind, but they accept them as the best compromise available.

The other controversial amendment is the proposal to issue patents for chemical products. In most countries, chemical processes can be patented, but not products. There are a variety of national laws that restrict patents on products that are considered important to the public welfare—foodstuffs and drugs in particular. A British court, for instance, recently held that even the Convention grace period does not apply to drug products, which under British law are subject to compulsory licensing at any time.

Actually, one of the most important decisions at Lisbon may be to rewrite the entire text of the Convention. The document is now 75 years old, and it has been patched with amendments and subsections, with subject matter hopelessly intermixed. The Convention has worked well to date, but many delegates would like to make a clean, fresh start. Another amendment would make it mandatory for a nation to give effect to the provisions of the Convention—by passing necessary laws—before ratifying it. And the International Court of Justice would become the official court for violations. ●



Western Europe's industries are consuming more capital goods...



...while consumers rush to buy the better things of life.

Toward Better Living in Europe

THE NEW YEAR is approaching, and with it the first tariff cuts under the European Economic Community treaty. Yet the problems and politics of the Common Market, and of a Free Trade Area, sometimes obscure the opportunities.

The charts above show what European economic integration has to build on. They outline a momentum of demand that can carry Europe to new heights of production and good living.

The first shows how investment in new machinery has out-stripped gross production. This expansion reflects businessmen's confidence in the "new Europe," and their realization that they must invest to stay competitive. While there are signs that investment slowed a bit this year, few believe that the slowdown is more than temporary.

The promise resides with the consumer, who is just now getting a taste for higher quality consumer durables. The second chart measures the buoyancy of demand for these hard goods. To be sure, there will be fluctuations. But the slight decline in 1956 for all Europe was mainly the result of anti-inflation policies in the United Kingdom. Elsewhere, demand kept growing.

These charts are part of a recently-published study by the 17-nation Organization for European Economic Cooperation (*The Engineering Industries in Europe,* 298 pages, OEEC, Paris 1958). OEEC's study provides a mine of country-by-country information on Europe's engineering industries — covering investment, employment, supply, domestic and foreign trade, prices. ●

Expansion is the Strategy at IT&T

PRODUCTS of Lorenz AG—ISE affiliate—are inspected by Leavey.

GENERAL EDMOND H. LEAVEY (cover picture), president of the U.S.A.'s International Telephone & Telegraph Corp., is an inveterate business traveler. In the tradition of the former military officers who have headed the company, he says: "It is as important for the commanding general to be seen as it is to see things for himself."

Yet for all his sense of public relations, Leavey is primarily a strategist, mapping a world-wide expansion scheme to meet stiffening competition. That competition is largely directed at IT&T's powerful subsidiary, International Standard Electric Corp. With 24 companies in 20 nations, ISE accounts for two-thirds of IT&T's annual sales of $600-million, employs over 70% of IT&T's 128,000 payroll.

And it is growing rapidly under Leavey. Since he became president of ISE in 1954 (and later moved up to head the parent), Leavey has:

—Drawn up a new $100-million plant expansion for Western Europe, the Commonwealth, and Latin America, just now getting under way. All this on top of a five-year plan that has raised ISE's book-value investment from $90-million to $190-million.

—Helped increase ISE sales from $200-million in 1954 to $400-million in 1957.

—Helped ISE win a huge engineering contract to design a radio-telephone network for NATO (where Leavey was once Chief of Logistics under NATO Commander Eisenhower).

For all this growth, ISE (now headed by IT&T veteran Henry Scudder) is not well-known in the U.S.A. where it is owned—because all its plants are overseas. And it may be that many persons in nations where it does operate do not realize that ISE is U.S.-owned—because its plants have often been part of the local scene for years.

Yet both ISE and its parent have had a turbulent history. War and political change has shaped the companies' growth.

After World War II, IT&T lost its subsidiaries in Eastern Europe (and later in China). In several non-Communist countries IT&T phone companies were expropriated. This speeded the trend toward getting out of the telephone business into the more profitable field of making communications equipment.

"Cold war" over the past decade has indirectly benefited the companies. In the U.S.A., the parent is engineering guidance systems for the missile program. In Europe, ISE has put many of its 4,500 scientists and technicians to work on high-priority military equipment.

But not all the research goes into military gear. The Washington post

PROCESSES in German plant are described by manager Fricke (left).

office has an electronic letter-sorter developed by ISE Belgium. And ISE's British company has come up with a revolutionary method of purifying silicon. All in all, IT&T and ISE jointly hold 22,000 patents in 46 countries.

Many of these were born in IT&T's vast research organization, based in the U.S.A. and run by Henri Busignies, a French scientist with many important patents in his own name. It is a two-way street, with ideas flowing back and forth between the U.S.A. and big ISE labs in London and Paris and plants throughout the world.

Some of these plants have grown rapidly—despite the expropriation of other properties. When IT&T was forced to sell its phone companies in Spain and Argentina, it went ahead to capitalize on the manufacturing facilities that remained. Before expropriation, ISE factories in the two countries employed only 1,500 workers. Today they employ 10,000, making equipment for the nationalized phone companies, plus industrial and consumer products.

The story of IT&T subsidiaries in East Europe is something else again. Today they occasionally provide stiff competition for their former owner—especially in the Middle East.

But the primary sales battle is between ISE and competitors like Ericsson of Sweden, Siemens of Germany—and, to a lesser extent, Philips, Japan's Hitachi, the U.S.A.'s Automatic Electric Co.

The competition with Ericsson goes back to the early 1930s when Ivar Kreuger, the Swedish financier, was ready to sell out his controlling interest in Ericsson. Though IT&T deposited about $10-million in a European bank to cover the purchase, the deal never was closed. Some say that IT&T did not like the looks of Kreuger's books. Others suggest that Stockholm would not have approved the sale of a company as important to Sweden as L. M. Ericsson.

IT&T did manage to get about 27% of Ericsson stock, but not control. Today the two are frequently competitors. While they have worked closely together in Mexico (they controlled the nation's largest telephone company), IT&T and Ericsson are selling out to Mexican investors and will now emphasize—as IT&T has done elsewhere—manufacturing phone equipment rather than providing phone service.

Another rival is Siemens of Germany. Siemens uses its diversified production of electrical equipment and appliances as an entering wedge to make telephone equipment sales in foreign countries. ISE is less diversified—refrigerators in Argentina, TV and radio in Australia, vacuum cleaners in Britain, and not much else beyond its basic communications equipment.

What diversification IT&T has is primarily an extension of its communications activities. American Cable & Radio Corp., one of its subsidiaries, has affiliates in Britain, Spain, Latin America. And IT&T itself still has telephone subsidiaries in Puerto Rico, Cuba, Brazil, Chile, and Peru. (*Business Week, Aug.* 9, *p*60) ●

Italy Builds a Web of Roads

BULLDOZERS and giant shovels today are tracing a wide path through the rolling hills of Italy from Milan to Naples (map). First segments of the high-speed expressway—the "Highway of the Sun"—will be ready by the end of the year; the Milan-Florence section, by late 1959; the entire superhighway, in another three or four years.

This is a major item in Italy's extensive roadbuilding program, which now is moving ahead swiftly and on schedule. If plans develop as expected, by 1968 northern Italy also will be traversed by an expressway from Yugoslavia to France; another highway will lace the Adriatic coast, and others will link Italy's Riviera with France and Switzerland.

Looking further into the future—past 1968—are plans for a 225-km Naples-Bari toll-road, a 360-km highway from Naples to the tip of Italy's boot, and a 200-km link across Sicily. And while new construction goes on, improvement of old roads is not being neglected. Two-lane roads throughout the peninsula are steadily being widened, so that the nation eventually will have an integrated system of four-lane highways.

Most impressive today is the $300-million Highway of the Sun, where some 1,700 machines and 7,000 men are turning dirt and boring tunnels. The most difficult part is between Bologna and Florence. A 32-km section in the Apennine mountains just north Florence will require 16 viaducts and four kilometers of tunnels.

Greatest activity this month is at the Milan-Bologna section, where five major structures are being built. Included is the giant Po River Bridge, a 17-span, prestressed concrete structure 1,200 meters long.

Another highway where construction has just begun is the $45-million Brescia-Padova turnpike, completing the link between Turin and Venice. Four other major highways are being built in northern Italy, in the Turin-Genoa-Milan triangle. They will improve connections between Ligurian ports and the provinces of Lombardy and Piedmont. (*Engineering News-Record, Aug.* 21, *p* 58) ●

YOU CAN INSPECT TIMKEN BEARINGS JUST BY TOUCHING

WITH friction bearings on freight cars, the inspector has to stop at every wheel, lift or remove the journal box lid, probe around inside to make sure everything's in place. It takes time.

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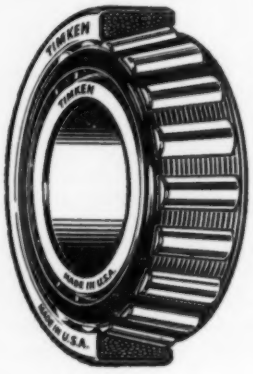


The Image is Blacker than the Record

Companies make considerable efforts to create a favorable public image. But the United Fruit Co. has a special problem in Latin America.

THE UNITED FRUIT COMPANY suffers the same problem as a reformed woman with a questionable reputation. The community refuses to forget those stories about the past.

Whatever the truth about its early life, it is undeniable that the U. S.-owned United Fruit Co. was primarily responsible for transforming the banana from a perishable tropical curio into a major item of trade.

This accomplishment meant revolutionizing the economies of several Latin American countries. As it drove to its dominant position, United Fruit acquired an unsavory reputation. But the election of Samuel Zemurray as Managing Director in 1932 marked the dawning of a more enlightened attitude. Zemurray said: "You can't do business that way today. We have learned that what is best for the countries we operate in is best for the company."

In the intervening years, United Fruit has made increasing efforts to revise its image in Latin American eyes. An impartial American economic study group, the National Planning Association (IMD—July, p 47), commissioned economist Stacy May and Galo Plaza, the former President of Ecuador, to evaluate these efforts. Their study was published a few weeks ago.

The study thoroughly explored all accusations levelled at United Fruit, and commented on these:

"It's too big." Often attacked as *el pulvo*—the octopus—United Fruit hardly ranks as a giant among U. S. corporations. Yet it overshadows the economies of several Central American lands.

"It manipulates governments," tries to get preferential treatment. The company has secured special contracts from most countries where it operates. But United Fruit assumes more obligations than benefits under these contracts.

"It uproots people." The company has destroyed the old way of life in many areas. But it also has brought schools, hospitals, homes where none existed before.

"It monopolizes good lands." Although United Fruit controls more acreage than it has under cultivation, the uncertainties of banana culture require maintaining large reserves.

"It fights trade unions." While the company did suppress trade unions in the earlier period, it now recognizes local bargaining groups.

"It robs the land" for the benefit of a few foreign shareholders. While United Fruit may have enjoyed exorbitant profits in the earlier years, it now returns lower than average profits to its widely-dispersed ownership—mostly small U. S. investors. And it leaves in the producing countries an unusually high 86% of the value of bananas shipped.

The NPA's investigation reveals the dual nature of United Fruit's problem: first, to change gracefully; second, to convince a skeptical audience that it actually is making this transformation.

In recent years, two dread scourges have swept the banana plantations, sigatoka and Panama disease. The control measures demand heavy capital backing and substantial reserves of land. Today, rather than expanding its own holdings to meet these challenges, the company encourages local growers by leasing or selling them banana land, then renting them the facilities to combat the diseases.

Undeniably, United Fruit and its competitors tampered with governments in the early 1900s and the company still enjoys certain special concessions. But the company has displayed a greater awareness of public opinion in negotiating its latest contracts. They spell out the social obligations United Fruit assumes to compensate for its privileges. And they now provide for a 30% income tax instead of the former property and franchise taxes. By paying taxes on income rather than assets, the company engenders a sense of local participation in its fortunes.

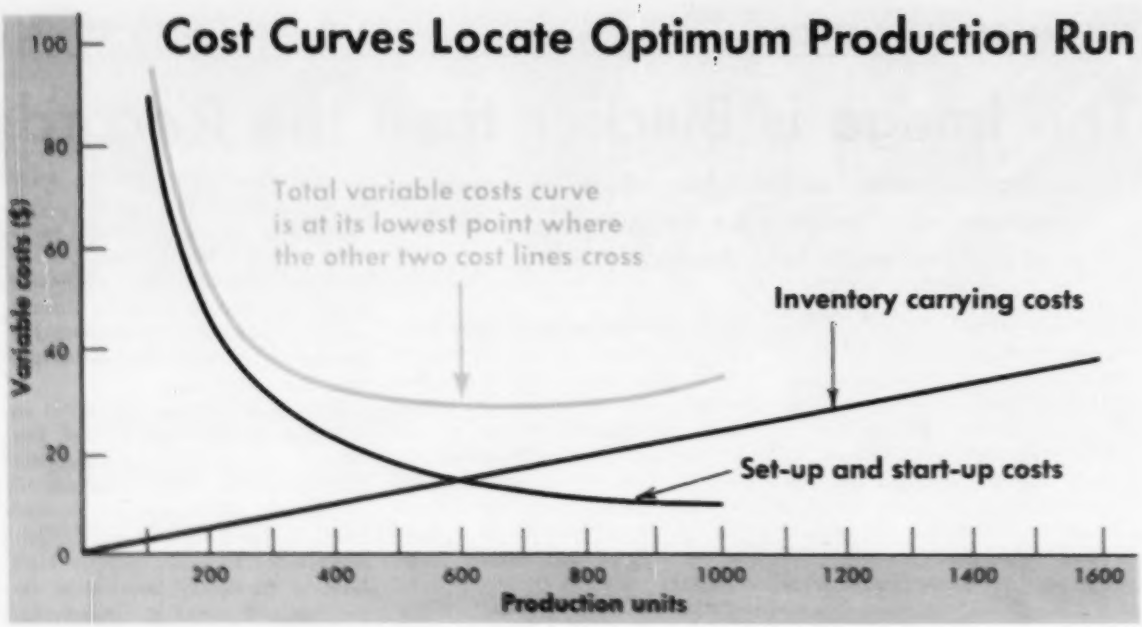
Banana operations have meant an upheaval for the workers too. For them, it frequently meant an abrupt transition to a rather regimented community life in company-erected barracks, far from any towns. This contributed to a disruptively high level of turnover. Now, more individualized housing, indoctrination programs have increased worker satisfaction. At the same time, an excellent medical program, non-profit company stores, and support of religious and recreational activities enhance plantation life.

In labor relations, the company has swung to a reluctant recognition of union power. Strikes hit hard in the banana business where tightly-scheduled, year-round harvesting calls for constant attention. United Fruit now provides building space for union activities.

However, the company may be accused of attempting to set up an inocuous company union to forestall more militant labor activity. There is no closed shop and the company has vigorously fought any federation of the local unions.

Ironically, the company—so frequently pictured as making huge profits—earns a considerably lower return than comparable international enterprises. With limited growth possibilities and a limited return, United Fruit shares are considered a mediocre investment.

The NPA report's conclusions show that United Fruit can present a cleaner record than it gets credit for. Since 1952 its management has been working to get the record straight. Trips to plantations are arranged so that the public can see the operations, and advertisements, news releases, company statements receive wide dissemination. ●



Planning Production Runs—With "OR"

THE THEORY of optimum manufacturing lots in a job-shop operation is demonstrated in the chart above. Set-up costs drop sharply as production volume increases; inventory costs—figured as a percentage of inventory value—increase in a straight line with volume. Only variable costs are used here; fixed costs would only raise the total values without changing the contour of the curves.

The problem for the management man is this:

Too small a number of units in a production run—the "lot size"—may not justify the start-up costs; too large a run may tie up a great deal of money in inventory.

Most shop managers determine lot size through experience, judgment, and guesswork. And so did the shop managers at the U.S.A.'s Western Electric Co. until an Operations Research team turned cost curves—like the ones above—into a formula for calculating optimum lot sizes, and then prepared easy-to-use nomographs so that production men would not even have to calculate square roots.

This is a good example of how Operations Research can aid the operating manager—in small establishments as well as large—and help him avoid badly-planned production runs which can easily dissipate profits.

I. Significant Equations

To an Operations Research specialist, the chart above has great significance. The lowest total variable costs is at the point where the cost lines meet (color). At this point, there is a mathematical equation with both sides equal—and with both sides a function of lot size. It is a simple mathematical step to transfer lot size to one side of the equation and cost variables to the other side. The result: a formula for optimum lot size.

The elements that go into the equation are:

Q = lot size
C = production cost of each unit
S = cost of set-up and start-up
P = period of demand, expressed as fraction of year
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I = annual inventory charge, expressed as percentage of value.

The curves in the chart are turned into mathematical equations like this:

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Inventory costs = $QCIP/2$

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Total variable costs are the sum of the two:

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Now, as the chart shows, total variable costs are at a minimum—and lot size at the optimum—where inventory and set-up costs are equal. Thus, at this point . . .

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With this formula, the optimum lot size can easily be found for any combination of D, S, and C. As an illustration, assume a shop manager has the following data:

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Substituting these figures:

$$Q = \sqrt{\frac{(2)(900)(\$10)}{(1/12)(\$5)(0.12)}} = 600 \text{ units}$$

All very well, many operating managers will say, but my cost figures are not that precise.

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II. The Formula in Action

Western Electric has one machine shop that is capable of making 20,000 different piece parts, with a wide variety of equipment. The size of this operation is significant only in that an electronic computer was needed to do the calculations.

A more meaningful problem: The shop figured its costs in hours —start-up time and manufacturing time—and not dollars. The operations researchers got around this by converting inventory dollar costs to an hourly basis.

From this cost data, the OR team prepared nomographs that cover more than 95% of the 20,000 items, to an accuracy of within 1%. Monthly demand for the items ranges from 10 to 85,000; optimum lot sizes range from 10 to 175,000. Savings from the use of these nomographs is estimated at over $200,000 a year.

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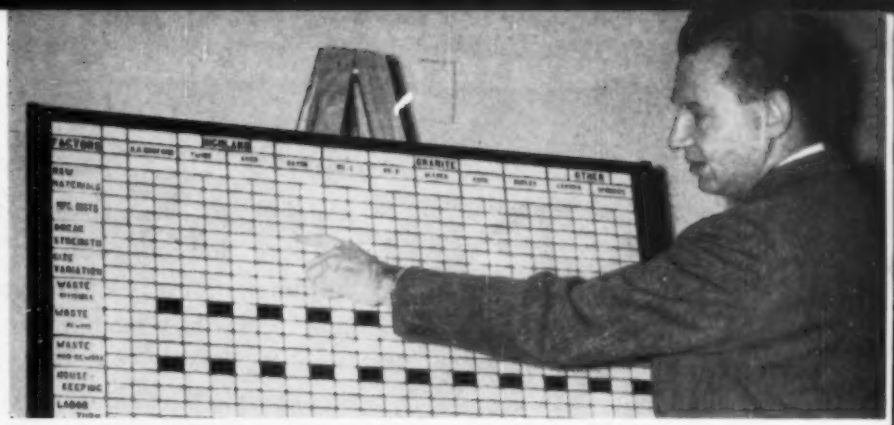

Display board shows ratings of eleven textile mills in . . .

New Measure of Performance

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Shuford's T-Scores are based on averages of the past 12 quarters—a "raw" average becomes 50 on the arbitrary scale. Thus quarterly operating figures that convert to above 50 are improvements over average past performance. The T-Scores indicate which mills are doing the best job of improving on past performance.

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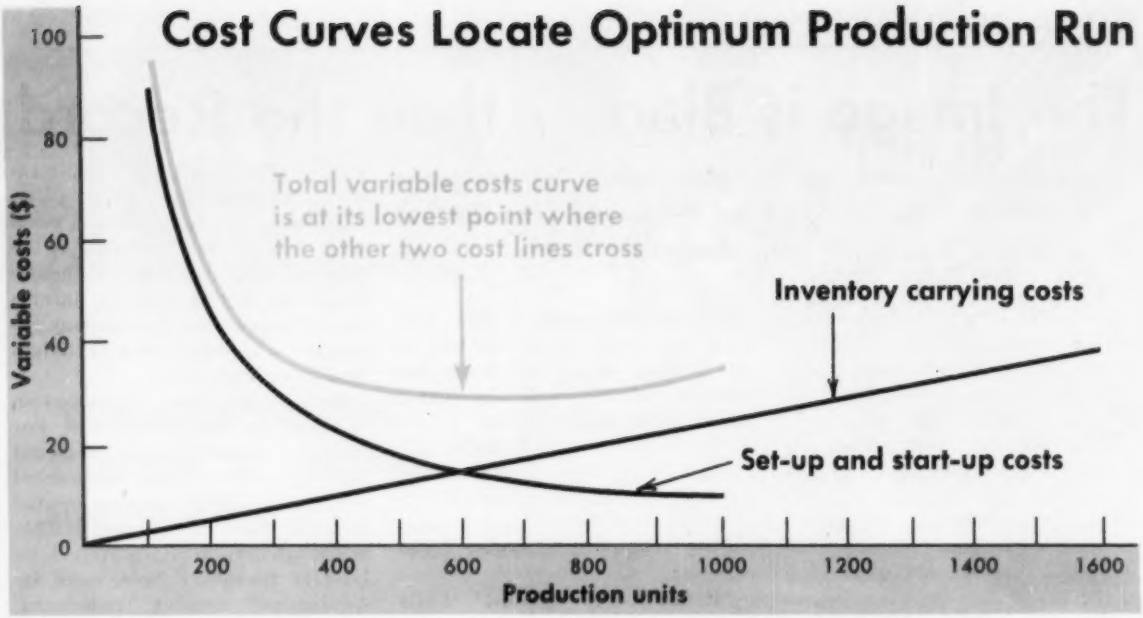

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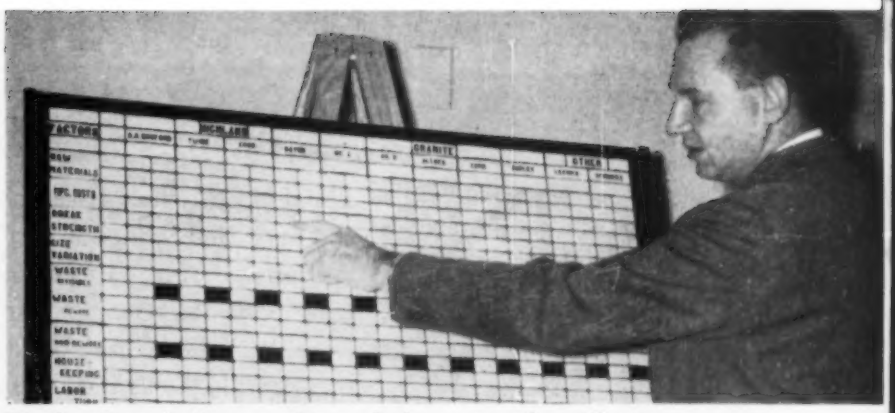

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Business partnerships—made through choice or necessity—are "internationalizing" management to a degree undreamed of a few years ago, and are creating problems and opportunities for businessmen everywhere. Here, the editors sit down with Prof. Emile Benoit (left), an expert in the field, for a report on this dynamic trend.

When Businesses Marry

IMD: We hear a lot these days about joint ventures—partnerships linking business organizations from several different nations. The newspapers are full of announcements that Company A from Germany or the U.S.A. has joined with Company B in Brazil or Belgium.

Tell us, Professor Benoit, is this partnership technique something new? Is it important?

BENOIT: International joint ventures are not really new—but they are more important today than ever before. They are becoming the preferred route for foreign investment to enter many nations. They help businessmen avoid difficult political and economic problems—especially problems of nationalism. Very often, joint venturing is the only practical way to do business.

IMD: But why at this particular point in business history?

BENOIT: Perhaps it is a reflection of the vast expansion of international business over the past decade . . . the rush of less-developed nations to industrialize, rapid advances of technology, changing trade patterns.

The European Economic Community is a case in point: Many European companies are getting together in joint ventures to be in a better position to take advantage of the Common Market. And many American firms believe that joint ventures with Europeans are the best way to assure themselves a place in that market.

You will see more joint ventures in Europe, in Central America and in South America as regional market schemes take shape. And you will see more of them in the Middle East, Africa, and Asia, too.

IMD: In other words, Professor, there are good economic reasons for the increasing interest in joint ventures. Are there any other management motives beyond these broad market considerations?

BENOIT: Actually, management's motives are much the same as in the case of domestic combinations and mergers, only the parties happen to be on opposite sides of a national boundary.

Among the obvious reasons are the desire to extend vertical integration; to assure a stable source of supply or market outlet; to acquire patents or technology developed by a foreign firm; or to capitalize on a special situation. For example, the head of a family firm dies and his death creates the need to reorganize. Or a licensor decides he wants to have a voice in the management of a licensee company.

IMD: How about the desire to limit competition?

BENOIT: Well, there is what you might call a relaxed attitude toward cartels in many parts of the world. And buying into each other's operations and exchanging directors have often seemed the best way to stabilize a complex market structure.

But joint ventures are also important as a means of competing. If a foreign investor wants to get into the machinery industry in, for example, Germany, he might find it extremely difficult to do it on his own. His best strategy might be a joint venture with an existing German producer.

IMD: Are there important advantages in having local management associated with a foreign investment?

BENOIT: Enormous advantages. The contacts, experience, and general enterprise of local management in labor relations, marketing, and dealing with the government are often irreplacable. Moreover, since top management is so often related to ownership in many parts of the world, it is often impossible to obtain the services of top managers except through some kind of partnership arrangement.

IMD: Before we get further into the subject, Professor Benoit, perhaps you could explain exactly

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PROFESSOR EMILE BENOIT (above), of Columbia University's Graduate School of Business, is a well-known economist and business consultant. Together with Professors Wolfgang Friedman and Roy Blough (of Columbia's law and business faculties respectively), he has been studying business partnerships in Europe, Latin America, and South Asia. The project, now in its second year, is financed by the U.S.A.'s Ford Foundation; final results will be known in 1960. Here, in an interview with the editors, Professor Benoit makes the first public report on this important study of world business organization.

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"Finding the right partner is nine-tenths of the problem."

Story starts on page 18

what you mean by an international joint venture.

BENOIT: By a joint venture we generally mean a company in which ownership or control is divided between two or more national groups. Unilever is a good example. It has both British and Dutch capital and a Board composed of both nationalities. We also classify as a joint venture Unilever's Indian company because 10% of the stock is owned by the Indian public—though this does not significantly reduce Unilever's control. Similarly we include a case like Acero del Pacifico in Chile where management is shared with the U.S.A.'s Koppers Co. under a technical-assistance contract.

I call a 50-50 arrangement—where both partners have equal ownership, and equal voice in management—a symmetrical joint venture. If one partner has predominant ownership and control, I call it asymmetrical. There is also the pluralistic variety, in which there are several important groups. Then there is the unitary kind in which one partner has a clear and virtually undivided responsibility for management.

I also distinguish between homogeneous and heterogeneous joint ventures. If both national groups make technical and management contributions equal to their capital participation, I call it homogeneous. The majority of the world's joint ventures are probably of this type, and most of them are in Western Europe.

The heterogeneous type is more often found in the less-industrialized countries—the technical and management contribution is not equal to the partners' capital equity. Typically, such groups link one or more interests from North America, Western Europe, or Japan, with local private investment groups or perhaps a government agency.

IMD: Have you reached any conclusions on how joint ventures are being managed? Or how they can be best managed?

BENOIT: The main lesson of our research so far is this: As a practical matter, it is usually necessary to win the consent of all interested groups to the major policies that the joint venture will follow. A disgruntled minority can be a dangerous thing, particularly if this minority is of the same nationality as the government which controls the company's destinies. Thus, the "engineering of consent" is a major part of the job of managing a joint venture.

You might think that a 50-50 venture would be the hardest to manage. But this is not generally true. The fact of equality often induces confidence, and a more responsible approach to issues.

IMD: What kind of management does it take to make a joint venture work, Professor?

BENOIT: Well, let me tell you about the worst mess I ever heard of in a joint venture. This was a 50-50 company where the operating manager, an empire-building type, was protected against all interference by a director of one of the parent companies who had an effective veto on the joint board. In his urge to do a spectacular amount of business, the manager accepted contracts at unfulfillable terms. He ended by getting the two parent companies into real trouble.

There is no substitute for both groups giving close attention to what is going on and thrashing out their disagreements as they come to them. It is a laborious job. Certainly a company not willing to do this kind of work should not enter into a symmetrical joint venture, particularly a heterogeneous one.

IMD: You make joint venturing sound like marriage, Professor. Is that a good analogy?

BENOIT: It is! Finding the right partner is nine-tenths of the problem. The best marriages are often formed between partners who have been closely associated for many years. In joint venturing, there might be a past association as supplier-customer or licensor-licensee. And as in marriage, there is nothing so important as mutual confidence, and basic agreement on values.

IMD: Could you give us an example of marital troubles?

BENOIT: One frequent source of trouble is failure to agree in advance on growth policies. I know of several partners from industrial nations who are entirely dissatisfied with the rate of growth of their joint ventures in less industrialized nations. They are willing to put up the additional capital to expand, but their local partners—or the governments—will not agree, because this would upset the 50-50 balance.

Another frequent disagreement is over plowback and dividend policy. This seems to be a particular complaint of many U.S. companies. In many parts of the world, a common stock is regarded almost the same as a high-grade industrial or utility bond: The investor expects an immediate, stable, and high return. There is little sympathy for a heavy reinvestment of profits in the early, developmental phase. And there may be disagreements over the role of professional management—nepotism is certainly a marital difficulty!

IMD: Aside from such difficulties, are there any other reasons why companies shy away from joint ventures?

BENOIT: It is possible for a company to lose a certain amount of flexibility. Suppose, for example, a company has operations in both Belgium and Germany. Tax laws are quite different. Belgium taxes undistributed earnings at around 28% net, but dividends are taxed at up to 45%. Under the new German tax law, dividends will be taxed at only 15% or so, while undistributed earnings will be taxed higher.

Management's strategy, of course, would be to reduce the distributable profits of the Belgian company and increase those of the German company. The Belgian company could lend money to the German company, the German company could earn fees by having a management contract, or by having directors on the Belgian board.

But with joint ventures in each country, a company could not do this without hurting its partners.

continued on next page

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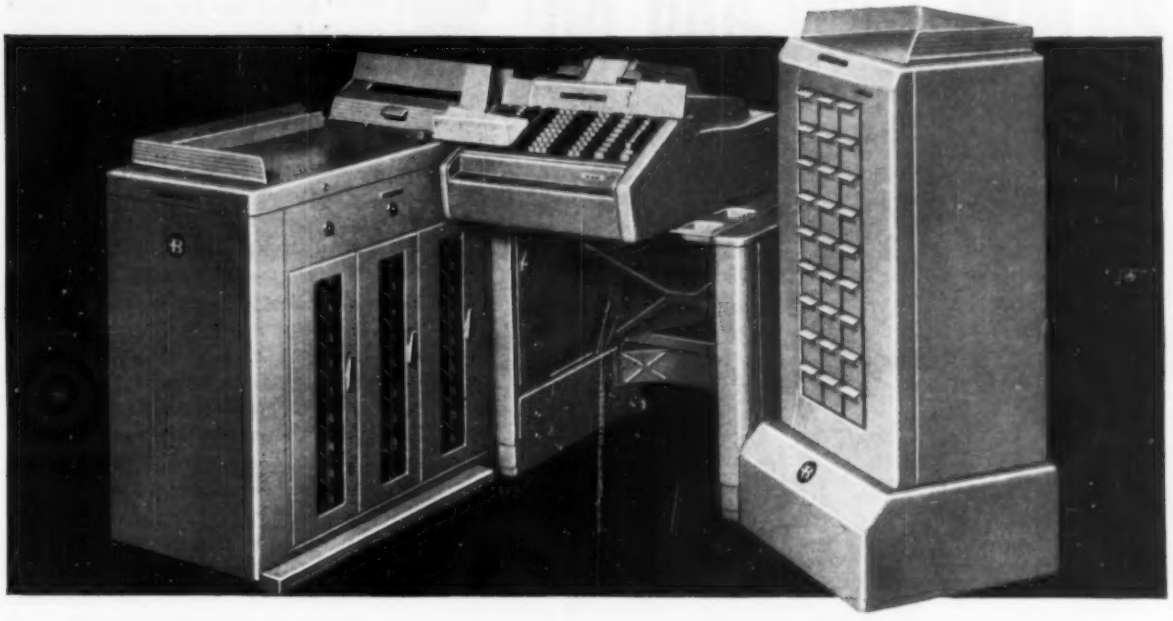

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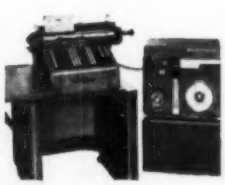

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"Politics is often a very important factor."

Story starts on page 18

Another aspect of flexibility is this: Taking on foreign partners may mean disclosing business secrets. Where secrecy is an important asset, a joint venture may be a liability.

IMD: There is one other difficulty we would like your views on, Professor. Do the U.S. anti-trust laws present a serious handicap for American companies and their joint venture partners?

BENOIT: Probably not unless the primary interest of the joint venure is to restrict competition, or if it is between large international competitors. But there have been some positive court decisions and consent decrees that have created alarm as to their possible implications. So some U. S. firms prefer to operate solely through foreign branches—despite the frequent tax handicaps of such an arrangement.

IMD: From what you have said, Professor, we gather that joint ventures in the less industrialized regions are quite different from the ones in the highly industrialized regions. Would you elaborate a bit, please?

BENOIT: There is a distrust of foreign investment capital in many less-developed countries. Politics is often a very important factor. If a government favors local participation in foreign investments, it becomes a legitimate business motive of considerable weight. Local regulations sometimes preclude branch operations or wholly-owned subsidiaries, and specify the minimum local participation. Even where not legally compulsory, joint ventures may still be preferable because in practice they may get better treatment in crucial matters such as import licenses for materials or components.

IMD: As an outside observer, Professor Benoit, do you think the underdeveloped countries are helping or hurting themselves with such restrictive policies?

BENOIT: A lot of foreign capital is scared away. And, furthermore, what capital does come in has to

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"Things are not as simple as they may look . . ."

Story starts on page 18

make up for the additional burden through extra profits. But I also understand, I hope, the history of colonialism that so often has given rise to these negative attitudes in the less-developed countries.

On the other hand, there may often be very helpful side effects of what we might call forced marriage joint ventures.

IMD: You mean the reluctant bridegroom finds that marriage is not so bad after all?

BENOIT: The director of one great international firm told me a revealing story. He had strongly resisted the attempt of a government to force his local company to sell part of its stock to the public. But finally he capitulated and the stock was sold. The unexpected result was an outburst of national pride, with highly favorable increases in employee morale and productivity. And the company won the confidence and friendship of the government.

Another director told me he had entered into partnership with a socialist-minded government with the gravest misgivings. As it turned out, the civil servants assigned to the Board transmitted back to the government an entirely new conception of what private enterprise could accomplish. Moreover, the civil servant-directors could convince the government of the need for more imported material, a price increase, or what-have-you. Company officials would never have been believed.

IMD: Have you any parting advice for our readers who may be thinking about joint-venturing with foreign businessmen?

BENOIT: They should be on the watch for what my revered philosophy teacher, Alfred North Whitehead, used to call "The Fallacy of Misplaced Concreteness." Simple profit calculations can sometimes give the wrong answers when human emotions are involved. Things are not as simple as they may look to a hard-headed businessman who is working in a social and business system quite different from his own. ●

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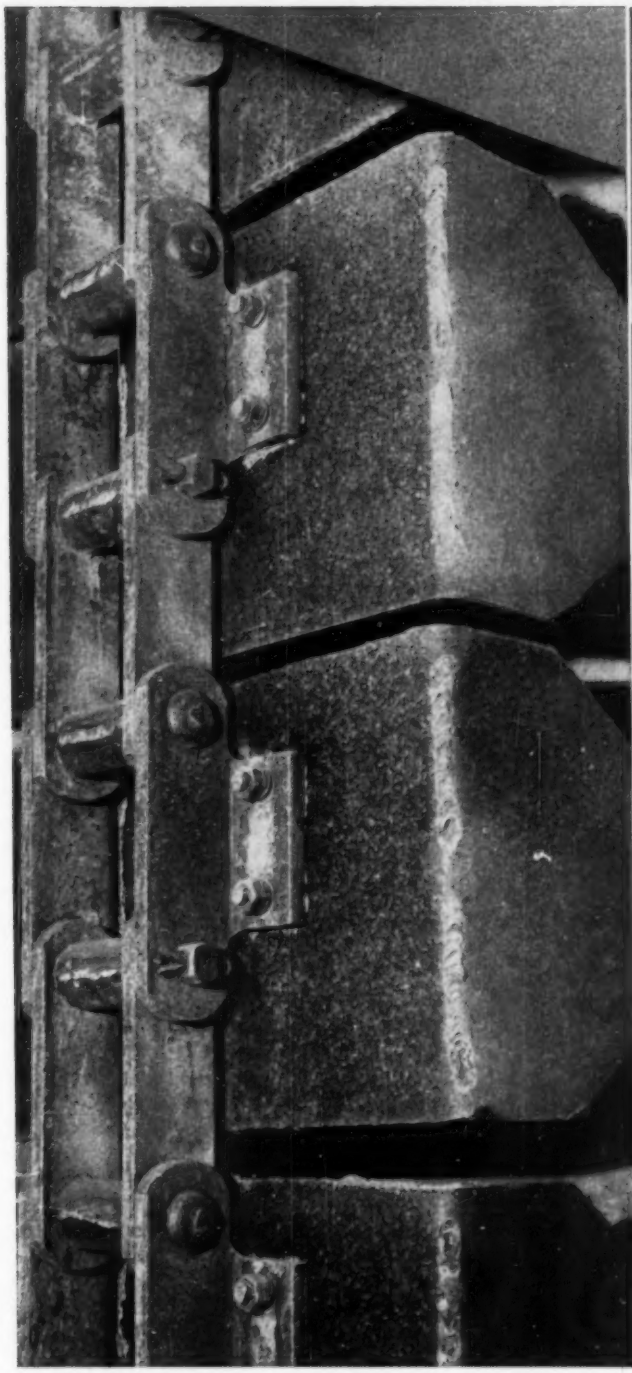

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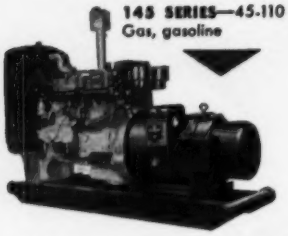

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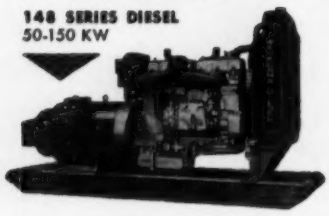

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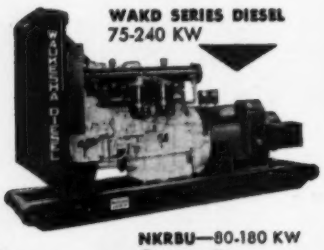

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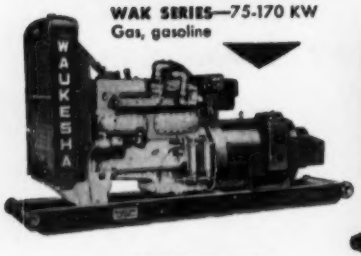

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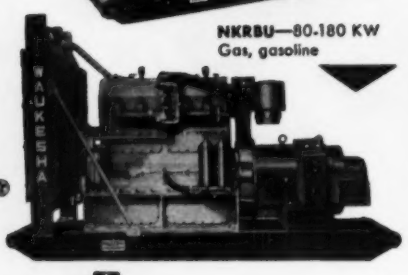

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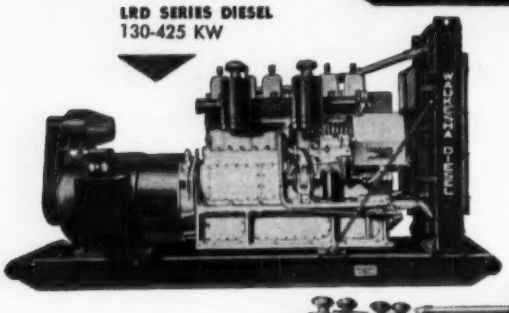

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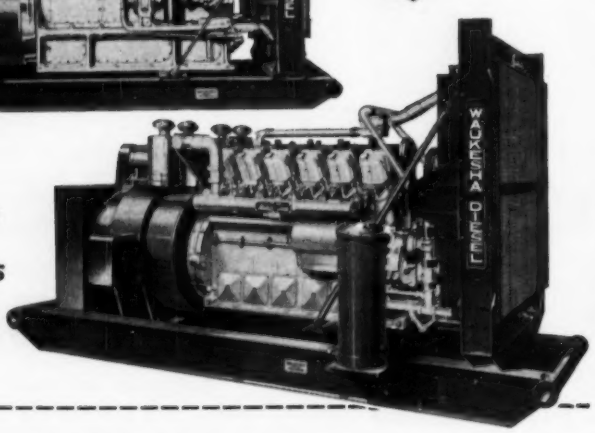

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In Management

SELF-IMAGES of 463 managers and 320 workers who described themselves—in perhaps idealistic terms—through a "checklist of paired adjectives" in a survey by a U. S. university turned up these differences:

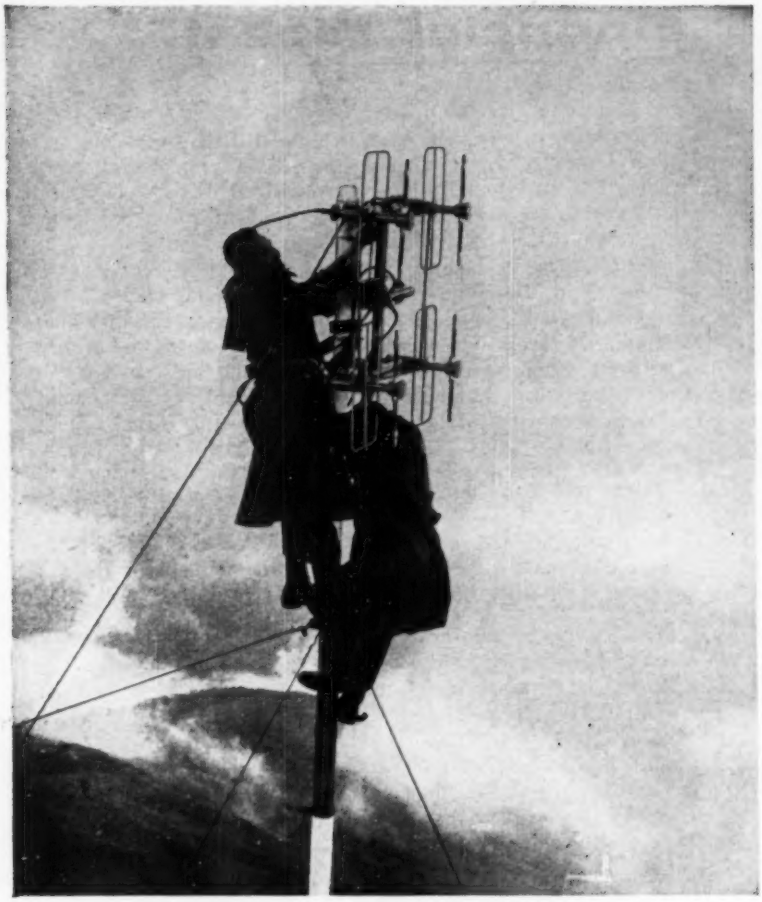
Managers see themselves as "independent of thought and action," "fair-minded," "responsible," and "having high initiative." Workers see themselves as "capable, not stubborn or outspoken," "steady and reliable," and "even tempered, with more control over their emotions than members of management have." (*Factory Management and Maintenance, August, p*104)

QUALITY CONTROL should be the responsibility of the operator as far as possible, recommends a report of Europe's Institution of Production Engineers. Companies like Volkswagen, Renault, and Solex (Paris) are pointing the way by turning inspectors into roving "product research" specialists. They test tools, machines, and production continuously, and they have the authority to modify tool-changing schedules, etc.; but the operator himself has the tools and the responsibility for maintaining quality. (*Business, August, p*21)

VOCATIONAL TRAINING LAW now in effect in Japan will provide job-seekers with basic industrial skills, at government-operated training centers. Trainees will be given certificates as "first-class" or "second-class" skilled workers.

HANDICAPPED EMPLOYEES at the U. S. A.'s E. I. du Pont de Nemours & Co.—from laborers to managers—rate on job performance 27% above average, 60% average, and only 13% below average. Those disabled before employment, however, generally make better ratings than ones disabled after employment, evidently because of a stronger drive to succeed.

Du Pont does not create jobs for the disabled; their abilities are fitted to the job. Handicaps range from cardiovascular diseases to total blindness and deaf-muteness, amputations and paraplegia. (*Chemical Week, August, p*50)



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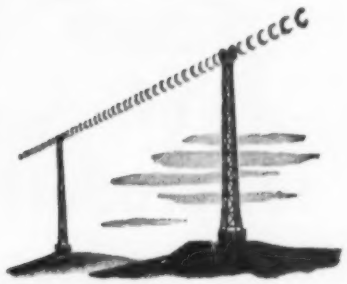

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Financial Digest

The American-South African Investment Co. Ltd., considered "a test" of the American market for foreign stock issues, has successfully been formed and is now offering a million shares at $28 each. It has applied for a listing on the New York Stock Exchange.

"This is the first time," comments the *New York Journal of Commerce*, "that an investment company has been allowed to raise funds for investment in foreign securities other than Canadian." Over 50% of total assets will go into gold mining and related common shares, with possibly 25% invested in gold bullion, and the balance in other South African businesses. Most of the income and all capital gains will be reinvested.

Japan will issue its first bond issue in the United States since the war, if the "scouting" now being done by an investment bank indicates a market. Before World War II, Japanese securities were highly regarded around the world—and payment has since been resumed on defaulted bonds.

The exodus of gold from the U.S.A. (*IMD, April p* 9) will stop and perhaps reverse before the end of the year. The U.S. has lost some $1,500-million this year to nations rebuilding gold stocks depleted during the Suez crisis. About half of the gold went to the United Kingdom.

But now, seasonal purchases and debt repayments will drain dollar reserves; and higher interest rates in New York can be expected to draw surplus dollars into U.S. Treasury bills or bankers acceptances instead of gold.

"Credit-rate" war was touched off in Britain when commercial banks, led by Midland Bank, entered the personal loan field. Depositors can borrow up to £500 for any "reasonable" purpose with little or no collateral—and at the same 5% charged by the hire-purchase plans of retail stores. The difference, however, is that interest paid on bank loans is deductible for income tax purposes.

A large retail organization struck back by cutting its rate to 3¾%, and the "war" was on. (It should be noted that the actual interest charge is higher than the nominal rate: The rate is paid on the full amount while the borrower is reducing the debt in installments. This is common financing practice.)

In India, the Bank Act has been amended to permit commercial banks to make hire-purchase loans. . . . **And Puerto Rico has its first commercial financing firm,** National Credit Corp., specializing in providing businesses with revolving working funds through the financing of accounts receivable, inventory, machinery. The U.S.A.'s James Talcott, Inc., will supply technicians and have an option on rediscounting National's receivables.

Austria's pilot project to spread corporate ownership of denationalized industries has passed its first milestone: a 7% cash dividend for the 86,000 holders of People's Shares. Further denationalization may follow the same plan.

Attracting U.S. investments is the goal of the Central American Investment Conference in Costa Rica in February. Following three days of discussions, U.S. business leaders will be taken on an inspection tour of projects in five countries.

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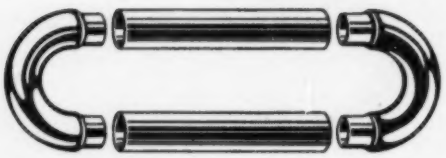
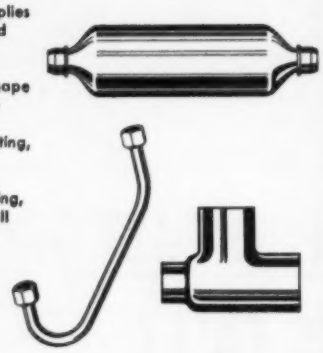


STANDARD AND REFRIGERATION TUBING

For all piping, refrigeration, and air conditioning requirements, Mueller Brass Co. Streamline copper tubing is available in all required wall thicknesses, and hard or soft tempers.

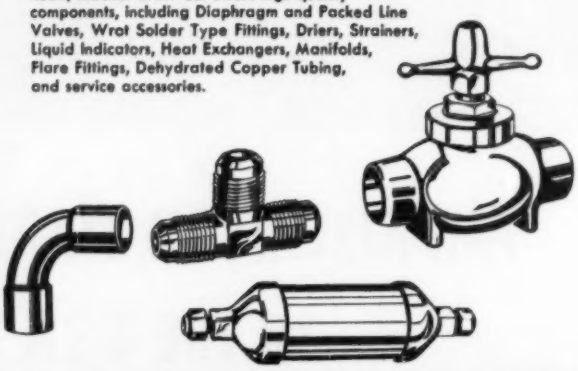
FORMED COPPER TUBE AND ASSEMBLIES

Mueller Brass Co. supplies formed copper tube and assemblies with special bending temper. Cut to customer's size and shape specifications. Complete facilities for swaging, bending, spinning, upsetting, flaring, flattening or sealing, beading and grooving, drilling, piercing, machining, joining . . . all at consistently close tolerances.



REFRIGERATION PRODUCTS

For virtually every refrigeration and air-conditioning need, Mueller Brass Co. offers high quality components, including Diaphragm and Packed Line Valves, Wrot Solder Type Fittings, Driers, Strainers, Liquid Indicators, Heat Exchangers, Manifolds, Flare Fittings, Dehydrated Copper Tubing, and service accessories.



APPLICATIONS

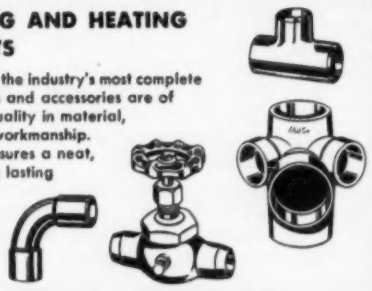
For sugar and paper mills, breweries, distillers, and other industrial applications, Mueller Brass Co. copper tubing is supplied to customers' specifications.

PACKING

Mueller Brass Co. can pack mixed groups of items for delivery to different job sites for any customer—an added saving to you by reducing rehandling costs.

PLUMBING AND HEATING PRODUCTS

"Streamline", the industry's most complete line of fittings and accessories are of the highest quality in material, design, and workmanship. Streamline assures a neat, efficient, long lasting installation.



PLASTIC PIPE AND FITTINGS

Rugged Streamline polyethylene plastic pipe and all types of fittings, both copper and plastic, are excellent for a variety of jobs where the flexibility of plastic is needed.

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Technology

Bull-Driven Generator Shows Promise

The old and new join hands in a novel electric generator and pump developed under the auspices of U.S.A.'s Ford Foundation and the Indian Community Development Ministry. The device may benefit India's tiny villages, —where four-fifths of the country's people live. It is run by bullocks, whose plodding around a fulcrum in one direction produces 4.5 kilowatts of electricity. When the animals reverse direction, they pump enough water to supply villagers and irrigate 40 hectares of land. The device will sell for about $3,000 when it gets into full-scale commercial production. (*Electrical World, Aug.* 4, *p* 57)

Thailand Fish Plant Uses Automation

The Thais have recently opened—at Bangkok—a fish processing and freezing plant with advanced refrigeration and automatic controls. The plant has three refrigeration systems, and is equipped with ten ammonia compressors, more than 6,000 square meters of fin coils, a blast freezer, and an ice-making unit. Nerve center of the plant is a control panel in the machine room. An array of lights indicate what is taking place in storage rooms, what thermostats are calling for refrigeration, which valves are open or closed. (*Food Engineering, July, p* 97)

Tubes the Size of A Human Hair

Quartz tubing no larger than a human hair has been developed for atomic research work by U.S.A.'s Monsanto Chemical Co. The microtubing was used by the Atomic Energy Commission to make microbalances that can accurately weigh materials to a millionth of a grain. Monsanto chemists say the tubing is so small that it takes a 15-meter length to hold a drop of water. It is about 75 microns in diameter, and is made of material that is extremely flexible, very inert to chemicals, yet has greater tensile strength than steel. Dr. Joseph J. Burbage, director of development for Monsanto's inorganic chemicals division, says the tubing also will be used in a new cell for recovering helium from natural gas. Each cell will use over 2,000,000 kilometers of tubing.

Open-Type Motor Runs in Salt Water

The open-type motor shown churning bubbles in the photograph is running fully loaded in a tank of 4% salt water. Allis-Chalmers Manufacturing Co., U.S.A., accomplished this feat by supersealing the motor's rotors with epoxy resin. The epoxy casting completely encloses the windings in a hard protective case, which also covers the slot portions of the stator. The motor is made impervious to moisture, and resistant to attack by solvents, oils and most chemicals. Applications that previously required motors with expensive enclosures, Allis-Chalmers says, now can have protection built into motor insulation.

Turn the page for more TECHNOLOGY

Miners Get a Ride to Work

Johnstown Coal & Coke Co. of the U.S.A. is now moving miners to the pit by means of a "Manveyor," a conveyor belt some 65 centimeters wide that travels at a speed of about 45 meters per minute. Miners travel down a 20-degree slope and reach a level about 30 meters below ground in 3 minutes. (*Business Week, Aug.* 9, *p* 98)

Advanced Fusion Technique Reported

Britain's Atomic Weapon Research Establishment (Aldermaston) recently disclosed first details of a new fusion technique that may eventually be used in the Zeta Mark II, the apparatus being designed to achieve the 100-million-degree temperature required for self-sustaining fusion. The new "quick pinch" technique heats the gas plasma primarily by the compression of the "pinch", rather than by the ohmic heating process. (*Chemical Week, Aug.* 2, *p* 47)

Reservoir Has an Asphalt Floor

A new small reservoir in California has two exceptional features: a simple wood roof and a base lining made of two layers of asphalt. The roof combines pre-cast concrete columns, glued laminated timber girders, wood purlins and joists, and a plywood membrane. The lower layer of asphalt was mixed by mobile units and spread by bulldozers, then compacted by vibratory rollers. Above this was laid a covering of asphalt panels, each 7 meters long by a little over 1 meter wide and about a centimeter thick. Panels were sealed with asphalt strips cemented with hot mastic. Early studies had shown that the asphalt lining not only would be cheaper than other water-retaining floors, but would offer good resistance to earthquakes and settlement. (*Engineering News-Record, Jul.* 17, *p* 49)

Undersea Mining of Sulfur

The world's first offshore sulfur mine soon will be opened 11 km. off the U. S. coast in the Gulf of Mexico. The sulfur deposit lies 600 meters beneath the floor of the Gulf in about 15 meters of water. The Frasch mining process will be employed, using air from the compressors and water heated by turbine exhaust gas.

Detroit Looks to Aluminum

No official word is out, but informed rumor has it that when General Motors Corp. comes out with its small car—probably in late 1959—it will be powered by an air-cooled, opposed-piston aluminum engine, in the rear. Other Detroit manufacturers may follow. They have noted the success of Germany's Volkswagen and Porsche—though these use magnesium rather than aluminum for their opposed-piston engine. Detroit designers apparently believe that both the V-8 and its front placement have had their day. Light-weight engines will save in space and weight, and they can be safely mounted at the rear. (*Business Week, Aug.* 16, *p* 44)

Electronic Sorting of Mail

Letter sorters at London's General Post Office soon will be pressing buttons as fast as their fingers can move and routing mail into 144 compartments at the rate of 3,000 items an hour. The first of 20 electronic sorting machines ordered by the Post Office has been built by Thissell Engineering Co., Bristol. Actually it can sort at a rate of 6,000 letters an hour—but no operator can read that fast.

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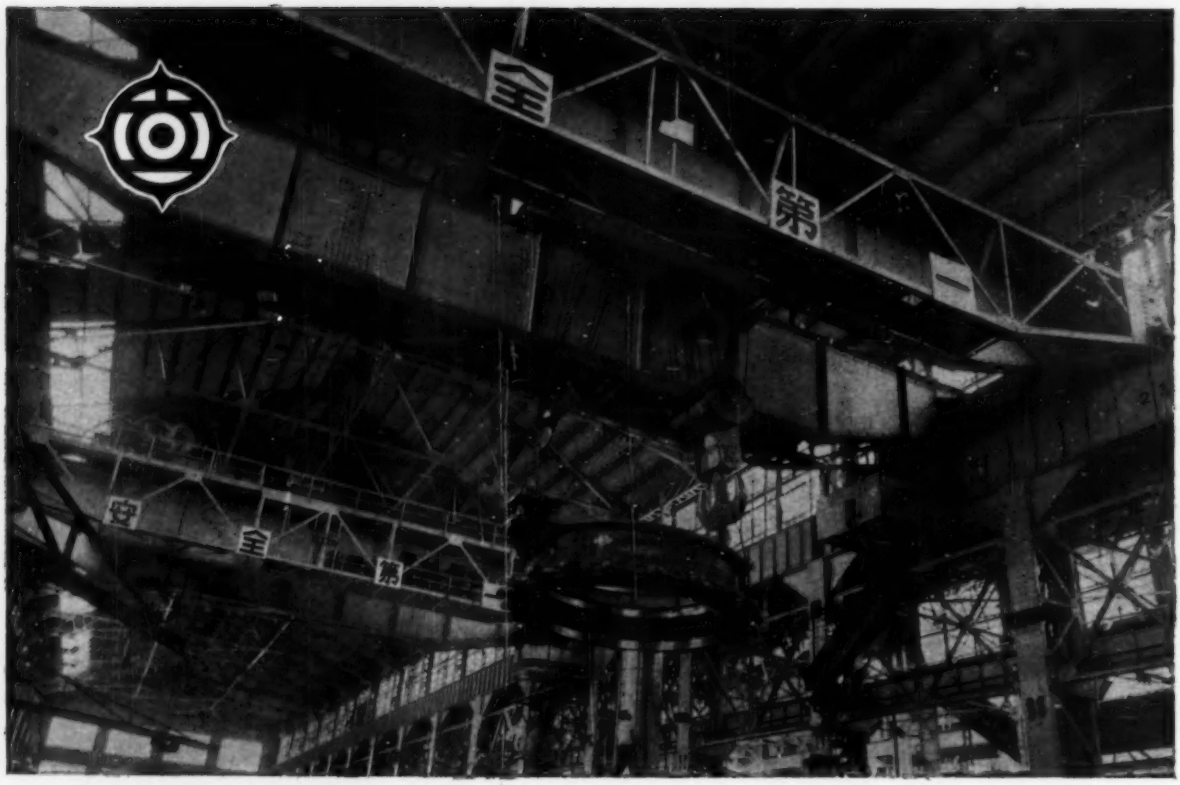

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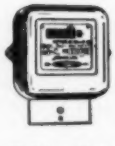

Watt-hour Meter

Pipe Fitting

Wire & Cable

Shale Oil Heads for the Market

Advanced techniques today are speeding up the processing of valuable fuel from rock rich in hydrocarbons.

HOW MUCH OIL is contained in the world's extensive deposits of petroleum shale is anybody's guess. Until recently, no one cared enough to find out. Shale oil had been used for more than a century in Scotland and other parts of Europe, but with the discovery of huge petroleum reserves in the Middle East and Western Hemisphere, its importance diminished.

What was needed was an economical and high-speed method of vaporizing the shale into its useful components. Such processes now are being perfected, and new attention is being given to the world's shale resources. Extensive studies are going on in Brazil; production of Swedish shale products is increasing; and a U. S. firm has plans for $3-million plant using a new, cost-saving process.

The Swedish Oil Shale Co., near Kvarntorp in central Sweden, has been processing products from shale for 15 years. Techniques have been greatly improved in recent years. New producing units have been added each year, and another 20% capacity increase is now under way. During the fiscal year ended in June, the firm produced 250,000 bbl of gasoline, 500,000 bbl of fuel oil, 22-million liters of propane and butane, 38,000 tons of sulfur, 24,000 tons of ammonia, and 55,000 tons of quicklime.

Oil shale consists of marlstone, sandstone, and kerogen (a compound of yellow wax-like hydrocarbons). When the shale is heated, the kerogen decomposes into shale oil, a liquid more like coal tar than petroleum. This can be refined by conventional methods into gasoline, jet fuel, and other useful products.

A recent development of the Swedish firm has been the use of underground electric heaters to vaporize the kerogen (photo, below). The heaters are placed in holes that have been drilled to the base of the shale deposits. Vapors leave the field slowly during a period of six to sixteen weeks after heating has begun.

The normal practice at Kvarntorp is the use of vertical retorts about 20 cm in diameter at the top and flared larger at the bottom. Shale fragments about the size of walnuts are fed at the top. Hot gases travel upward heating the shale to combustion temperature.

U. S. A.'s Oil Shale Corp. soon will begin using a shale oil recovery process that is said to be 50% cheaper than anything used to date. The firm has improved a basic process developed by Olof Aspergren, a Swedish engineer.

The process gets its heightened economy from mixing broken-up shale in a revolving drum with heated balls of metal or ceramics. This speeds up the vaporizing cycle from the 60 minutes required in older systems to 10 minutes.

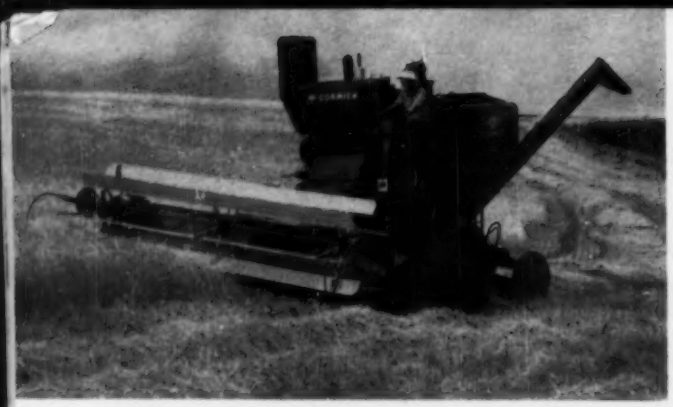
All sizes of shale may be handled by the improved process. Fines do not have to be removed, as is required in some plants. Developers say that their process results in less degradation of end products.

The crushed shale is heated to a temperature of close to 600 C. At this temperature, about two-thirds of the kerogen is turned into shale oil, another 10% into gas, and the residue becomes a solid coke.

The improved process came out of a two-year study by Denver Research Institute, Colorado, U. S. A., with a 24-ton-a-day pilot plant. On the Institute's recommendation, Oil Shale Corp. plans on a $3-million semi-commercial plant in the near future that will process 1,200 to 2,400 tons of shale a day.

A fully-commercial $23-million plant is also under study. Institute spokesmen say it would produce a shale oil comparable with low-grade crude at a cost of $1.42 to $1.92 a barrel. (*Petroleum Week, July 18, p 72; Aug. 8, p 31*) ●

ELECTRIC HEATERS now improve the vaporizing of oil shale at extensive fields near Kvarntorp, central Sweden.



New combine works on sloping ground, while special plane sprays seed and fertilizer.

Today's Farm Tools Have Many Talents

AT A MINNESOTA FARM, you can watch a five-ton mechanized pea-picker at work. As it lumbers along, it picks rows of cut pea-vines off the ground, flails the peas from their pods, and casts the shorn vines out behind it.

The machine has been hailed as the first major advance in pea harvesting in 50 years. Engineers hope it will enable farmers to cut by 25% the present cost of picking a hectare of peas.

These giant pea-pickers are typical of the agricultural machines of today—and tomorrow. They are powerful, but above all they are amazingly versatile.

The reason, as recent studies in *The Wall Street Journal* and *Product Engineering* show, is partly economic. In the United States there are now roughly 7.6 million men working 4.77 million farms averaging about 100 hectares each; in 1920 there were 13.4 million men working on 6.5 million farms of half the size. Yet farm production is some 60% higher than it was 20 years ago. So today's machines are being designed to help fewer farmers cultivate bigger farms and produce more food than ever before.

In Queensland, in South Africa, in many parts of Europe, and on the U.S.S.R.'s vast new farms, the background is similar. It is a story of rising wages of hired farm labor, rising operating costs, and an increased trend toward mechanization.

The versatility of some of the latest agricultural tools is something to be wondered at. A host of special attachments enable them to harvest rice, pick beets, pull radishes, dig potatoes, gather peanuts and pluck cotton. Corn pickers can now pick corn, husk it, and deliver it to an attached bin. A combine made by one manufacturer harvests both grain and soya beans when equipped with a conventional header, and with a special header can shell corn.

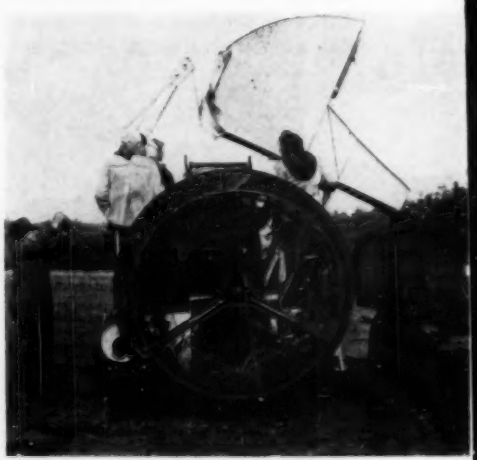
Perhaps one of the best examples of today's "machines of many parts" is a huge 12-ton monster that can plow, harrow, level, fertilize, plant, spray bug and weed killer—all in one operation. Its promise to do 460 man-hours' worth of farm work in 24 hours costs the buyer about $40,000.

Farm equipment manufacturers in the U. S. are not only turning out machines capable of performing increasingly complex tasks. At the same time they are increasing the size and horsepower of the more prosaic implements that are a familiar part of the agricultural scene. Within the past two years, several firms have built cultivators large enough to weed six rows of corn at a time rather than the usual four. (Note that 10 years ago two-row equipment was standard.) And one of International Harvester Co.'s latest combines (picture, top left) has an automatic hillside leveling device that keeps it operating at full capacity on slopes up to 37%.

In the past 15 years, too, tractors in the United States have almost doubled in power. An extreme example is one manufacturer's latest model, a 3-cylinder diesel that develops 83 hp. Not surprisingly, though, the rise in tractor horsepower has been accompanied by a rise in prices. And the mounting cost of the more powerful farm implements is another reason why manufacturers are increasing the versatility of their products to give the economy-minded farmer more value for his money.

Changes in agricultural practice also call for new types of equipment. More corn is planted today by the wheel-track method, with planting done in depressions left by the four wheels of the tractor. This does away with the disking otherwise needed in preparing a rough plowed field for planting, and requires only a special axle on the tractor.

Specially designed aircraft, too, help farmers in many areas of the world in sowing, fertilizing, spraying weed-preventives. The British-made Auster Agricola shown above (right) has an aerial spraying



POTATO HARVESTER at Dethlingen, Germany, needs few operators.

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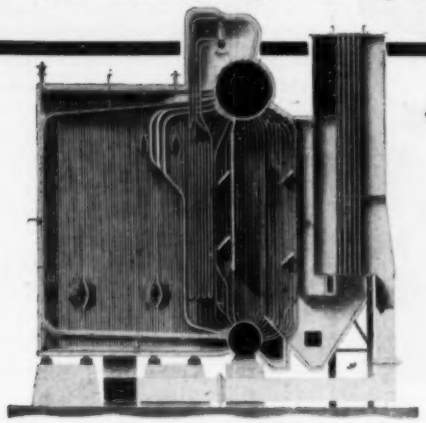
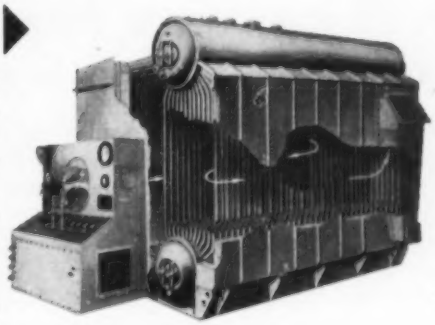


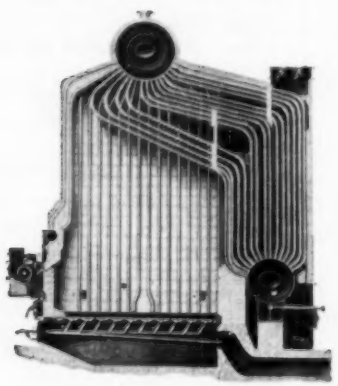
C-E Vertical Unit Boiler, Type VU-55

The VU-55 Boiler is available in five sizes ranging from 50,000 to 120,000 lb of steam per hr. It is designed for pressures from 250 to 750 psi for all sizes and for up to 300 degrees F of superheat. Heat recovery equipment may be added if desired. VU-55 Boilers are designed for the pressure firing of oil or gaseous fuel and require no induced draft fan. They are equipped with tangential burners and tangent furnace tubes to assure a level of performance which compares favorably with modern utility practice. Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. C-E drum internals assure high quality steam at all ratings. The absence of outside downcomer tubes and ducts makes possible the attractive streamlined exterior of the VU-55.

C-E Package Boiler, Type VP

This completely shop-assembled boiler is available in fourteen sizes from 4,000 to 50,000 pounds of steam per hour . . . for operating pressures up to 500 psi . . . for pressure firing of liquid or gaseous fuels. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large lower drum—30-inch diameter—permits a simple, symmetrical tube arrangement . . . greater water storage capacity . . . easy access for washing down or inspection. A centrifugal fan, which operates at low speed and is exceptionally quiet in operation, is standard equipment. The simple baffle arrangement results in low draft loss . . . simple soot blowing . . . no dead pockets . . . high heat absorption. The VP is enclosed in a reinforced gas-tight, welded steel casing, and shipped completely assembled with firing equipment, fittings and forced draft fan. For foundation, it needs only a simple concrete slab.





C-E Vertical Unit Boiler, Type VU-10

The VU-10 is available in nine sizes from 10,000 to 60,000 pounds of steam per hour . . . for operating pressures up to 475 psi . . . superheat to 200° F in 20,000-60,000 lb range . . . for solid, liquid, or gaseous fuels. This boiler is a completely standardized design adaptable to many conditions. It is bottom-supported and needs no outside supporting steel. It operates efficiently over a wide range of output, and is easy to operate and to maintain. All parts are easily accessible for inspection. The VU-10 is a complete unit—boiler, furnace, setting, fuel-burning equipment, controls, forced draft, heat recovery equipment (if desired). Regardless of fuel, the same general cross-sectional arrangement of drums, convection bank and furnace wall cooling is used. Uniform design through each transverse section assures even water level in the drum and uniform expansion.

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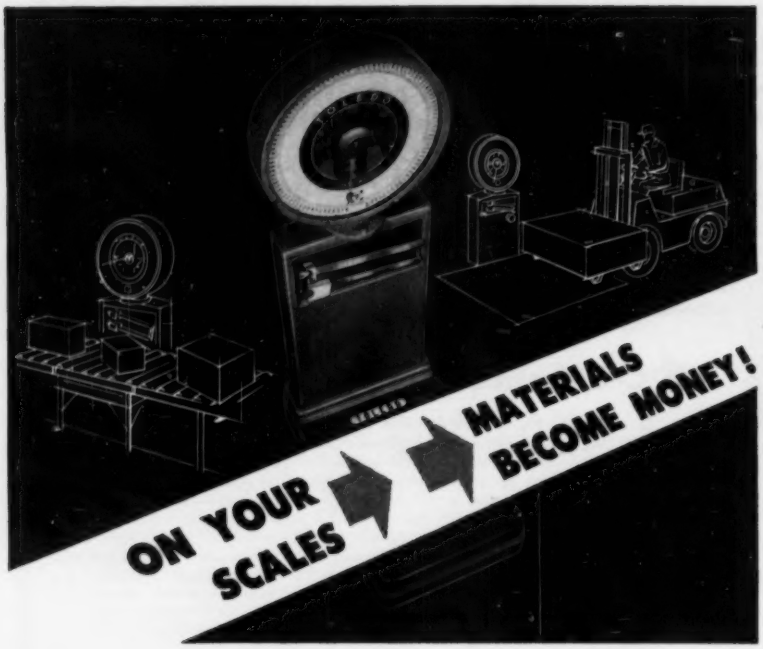

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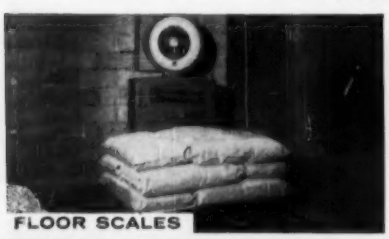
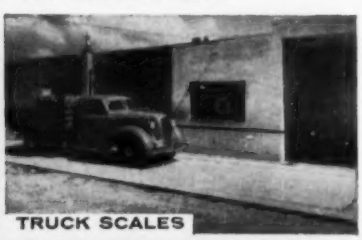

FLOOR SCALES


TRUCK SCALES

OVERHEAD TRACK SCALES

COUNTING SCALES

equipment that enables the plane to apply very heavy doses of spray fluid from the air. The aircraft is being put to work fertilizing hilly country in New Zealand. ●

Water Desalting Moves Closer

PRESIDENT EISENHOWER'S statement to the United Nations General Assembly in August that man's age-old struggle to end the world's water shortage was "on the threshhold of solution" struck many listeners as optimistic. But it was backed up by facts, as well as a desire to get the U. S. Congress moving on a $10-million program.

Congress now has authorized $10-million for five large water-desalting pilot plants. Three will be coastal sea-water units, the other two will process brackish water at inland localities.

Also behind the President's words was the progress being made by the several projects sponsored by the U. S. Office of Saline Water (IMD, Jan., p 49), and the fact that OSW's current budget is 50% larger than last year. Here are some added developments that justified the optimism:

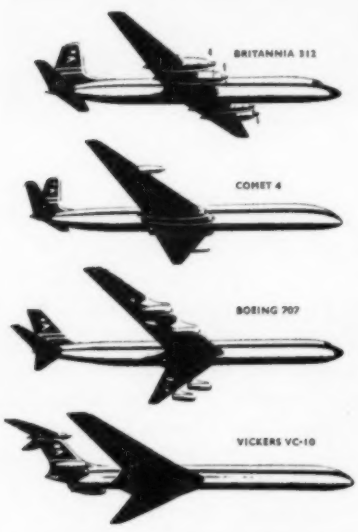
—**Construction recently was begun** (by Battelle Memorial Institute) of a prototype glass solar still in Florida, U.S.A. Designed by G. O. G. Loef, the installation will be the world's first deep-basin solar still, and will have an output of close to 1,000 liters a day.

—**Two shallow-basin plastic stills** will be built in coming months, under sponsorship of OSW. They will test designs and plastics of E. I. du Pont de Nemours & Co.

—**The office of Saline Water also is pushing ahead on freezing processes,** which hold promise of eventually competing with distillation methods. Laboratory studies have been promising, and now U.S.A.'s Carrier Corp. is designing a plant with an output of 55,000 liters per day.

—**The agency has hopes for nuclear-powered sea-water conversion,** though it does not expect it to compete commercially in the near future. A $100,000 study project in this field has been awarded to a California firm. (*Chemical Week, Aug. 30, p 31*) ●

BOAC streaks ahead in jetliner travel!



PROOF? Yes, indeed. BOAC Britannias, first jet-age airliners to fly the Atlantic, are proudly serving you today . . . and new Comet jetliners are already breaking records on transatlantic training flights in preparation for their introduction on the Atlantic later this year. Delivery of a fleet of magnificent BOAC 707 jetliners is expected next year . . . and already earmarked for BOAC early in the 1960's is a fleet of revolutionary new VC-10 jetliners — fastest, most powerful on the drawing board today. This is how BOAC is thinking and planning and acting . . . determined as always to lead the world in air travel — today and all the tomorrows to come.

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Power Lines Built from the Air

Helicopters and skilled pilots today aid in building steel towers, setting poles and pouring concrete.

CONSTRUCTION MEN from Mato Grosso in Brazil to Norway's remote fiords may well sit up and take a look at what some of their fellow engineers are doing in inaccessible mountains of California. High-power transmission lines are being built without the aid of service roads, sometimes without ever clearing underbrush from right of way.

Helicopters have come a long way as construction tools in recent years. For two California public utilities, besides hauling men and material, they are placing steel in towers, setting poles in trenches, pouring concrete, and stretching heavy wire.

Engineers of Southern California Edison Corp. recently gave a resounding vote of confidence to helicopters, after using them in four closely-studied power construction jobs. A Sikorsky S-58 capable of handling a 2-ton payload was used under contract, along with a light Bell helicopter. Edison now is specifying helicopter use on several projects.

The first job was a 42-kilometer, 63-tower section paralleling an existing power line where the hills had been cleared and supplied with service roads. The helicopter was used to transfer 593 tons of steel members, insulators, and hardware from three construction depots to tower sites.

The 593 tons were placed in about 63 hours, during 15 working days. A crew of eight, including a pilot and co-pilot, was used. The cost was $6.80 per ton-mile, comparable with trucking charges.

Once the helicopter started hauling, it touched ground only about twice daily for fueling. It hovered at about six meters when loading and unloading.

In a later job, framed wooden poles complete with crossarms and hardware were set by helicopter along a 6.5-km section of a mountain ridge. The pilot released the poles into their trenches electrically, and in the first hour placed 15 of them. Edison estimates that the cost was less than half of what it would have been by conventional methods.

Another firm, Pacific Gas & Electric Co., found helicopters practical in setting poles in inaccessible canyons while repairing storm damage. PG&E also used the same machines for laying 9,000 meters of steel line on crossarms without clearing underbrush and low trees in ravines.

Technical difficulties were encountered by both firms. Designers now are being asked to produce helicopters with greater safety and stability, and higher payloads. (*Electrical World, Aug.* 18, *p* 66) ●

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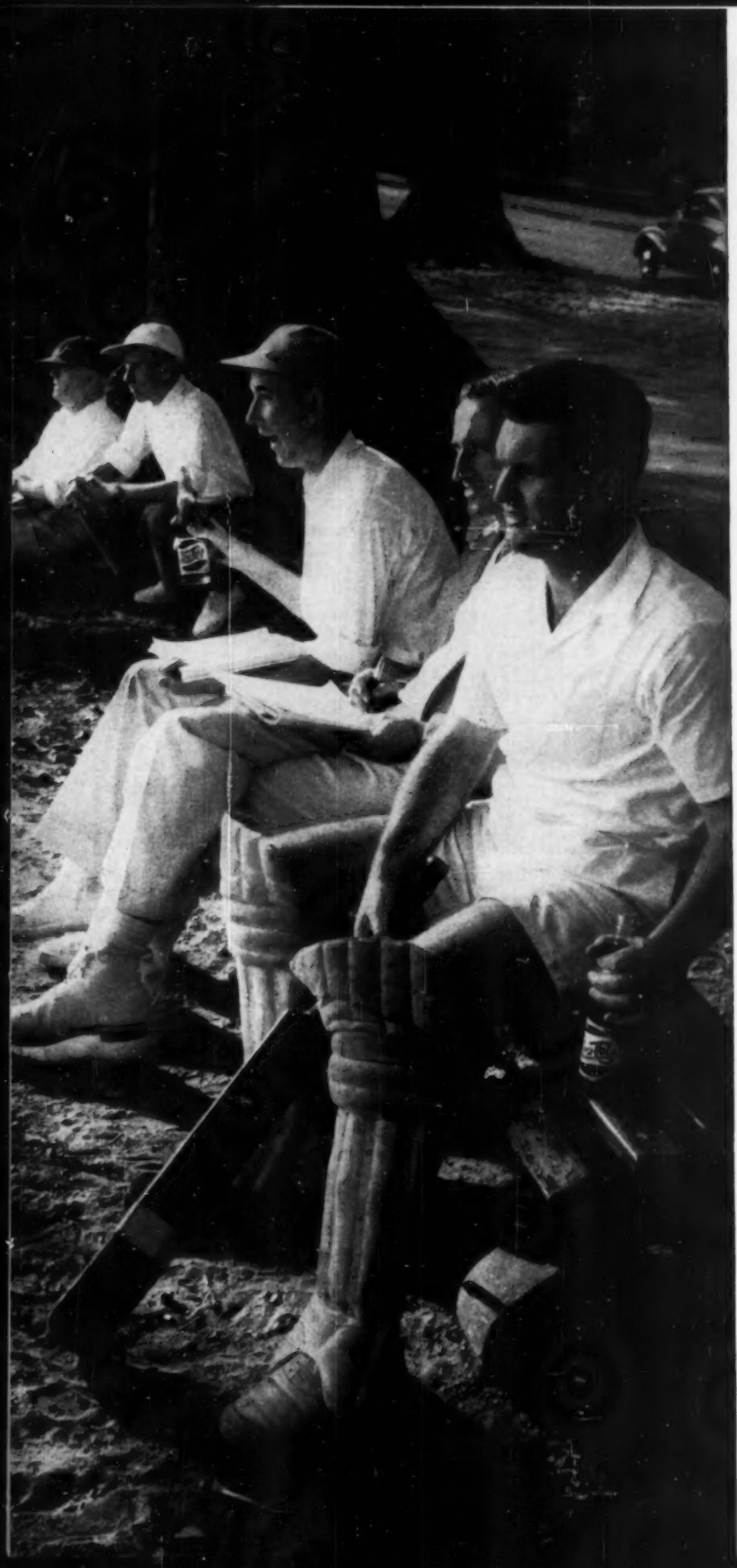

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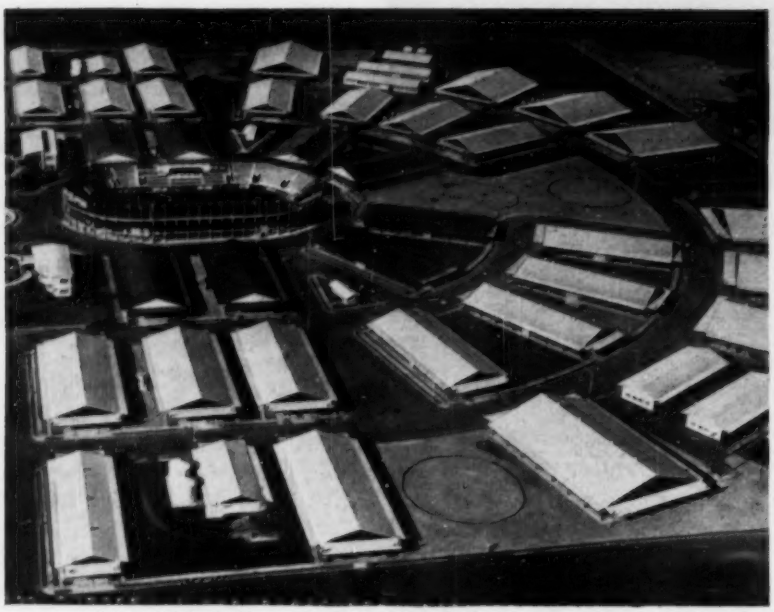

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British Improve Hollow Die-Casting

HOLLOW ARTICLES of any shape and with controlled wall thickness now can be produced in a single die-casting operation—without the customary cores. The high-speed, money-saving technique has been demonstrated in a prototype unit by the British firm of Robar Products (London) Ltd. The system can be semi- or fully-automatic. On a fully-automatic cycle, a control unit handles six machines at once.

Dies used in the Robar system have a longer life because lower temperatures are used and a rapid cycle—3 to 10 seconds—minimizes corrosion. Since cores are not required to produce cavities, tooling is greatly simplified. Also, many components previously made in two parts can be made in one.

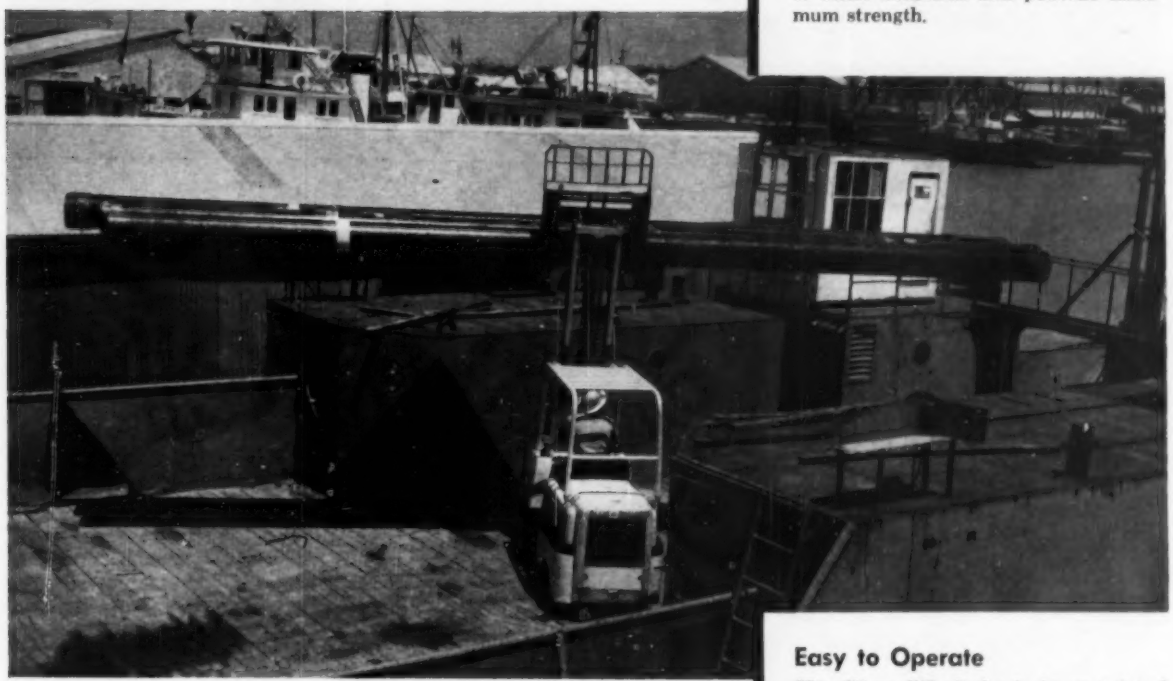
With the new technique, tubular portions in a hollow body can be cast with the use of only an externally inserted core. The body of a cigarette lighter, for example, is cast hollow with only the filler and wick holes in the shell. Small gas bottles of the ampoule type can be hollow cast in one operation with only cores for the tapped end holes.

The prototype machine uses a cylinder with toggle action made by Die Casting Machine Tools Ltd. Conventional dies and a normal die closing mechanism are used. The main change is in the injection system. In place of the gooseneck and vertical ram associated with hot-chamber machines, a charging cylinder is partly immersed in the molten metal and connected with a ball-type nozzle to the die injection tube.

Another advantage of the Robar system is that it reduces the flash on castings. Also, water-cooling of the dies keeps them in good condition, with no loss of temper and less distortion.

Both regular and irregular cavities with controlled wall thicknesses can be made with the new die-casting equipment. A production test of 170,000 pairs of hollow cast heels for ladies' shoes showed good internal surfaces and external surfaces that were dense and well suited to polishing or plating. (*Metalworking Production, Aug.* 1, *p* 1345) ●

ALLIS-CHALMERS LIFT TRUCKS SERVE MANY PURPOSES



This Load Tests Mast Construction

The slightest tilt of this load on uneven ground means a heavy strain on the mast assembly. But Allis-Chalmers masts are built to absorb it. The rigid, completely welded channel steel frame is designed to resist deflection and provide maximum strength.

Here is a common example of their superior versatility

A large chemical company stores its materials at one terminal from which shipments are made by water to five of its manufacturing facilities. One Allis-Chalmers 2,721 kg (6,000-lb) lift truck moves these materials into and out of storage and speeds loading at the dock.

A wide variety of loads are handled, ranging from sacked materials to pipe, and the unit is constantly in service. Each day provides added proof of its versatility, economy and durability.

For information on the many sizes and types of Allis-Chalmers lift trucks, consult the Allis-Chalmers material handling equipment dealer in your area, or write us.

Easy to Operate

Handling difficult loads in restricted areas requires a skillful operator and a powerful, responsive lift truck. Operators prefer Allis-Chalmers lift trucks because they start, steer, shift and drive like an automobile . . . and because they are safe to operate.

Ramps Test Clutches

Average clutches wear excessively from repeated trips with heavy loads up and down ramps or inclined platforms. But the heavy-duty clutches in Allis-Chalmers lift trucks are oversize . . . built to withstand constant work on the steepest inclines.

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Electronic Device Heats and Chills

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JUNCTIONS OF DISSIMILAR METALS may produce heat or absorb heat, depending on which direction the electric current is flowing. The principle was noted first back in 1834 by French scientist Jean Peltier—but now several large appliance makers appear ready to put it into commercial use.

At the bedside of the man in the picture is an example: an electronic device made by U.S.A.'s Westinghouse Electric Corp. that both cools and heats a baby's bottle automatically. Westinghouse is not interested in mass-marketing this product (it sells for $50) but is very much interested in future development of articles using the same principle.

Westinghouse also has a "hostess cart" that combines a refrigerator and oven in one cabinet. Other applications under study include refrigerated mixing bowls, combination heating and cooling blankets, and complete home air-conditioning systems.

All of these items will cool and heat through thermo-electric junctions. No moving parts will be required. All activity will be the result of an interchange of electrons.

Some years ago another American company used the same principle to build a prototype refrigerator. Several U. S. firms now are reported to be working on improved models.

Engineers point out these advantages for thermo-electric applications: They are quiet and vibrationless; they save in space and freighting. (*Purchasing Week, Aug 4, p 18*) ●

HIGHER PRODUCTIVITY has been one of the aims of industry during the past ten years in order to keep abreast of increasing demand, rising costs and greater competition. Philips, in particular, have been aware of the important contribution electronics could make to reach this end. Numerous examples can be found throughout the world of Philips installations and equipment used for speeding up, improving and economising production. If electronics can solve problems of productivity:

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REDUCED COSTS are no less important and here, too, Philips can supply electronic and mechanical apparatus that have already proved their value in many instances.
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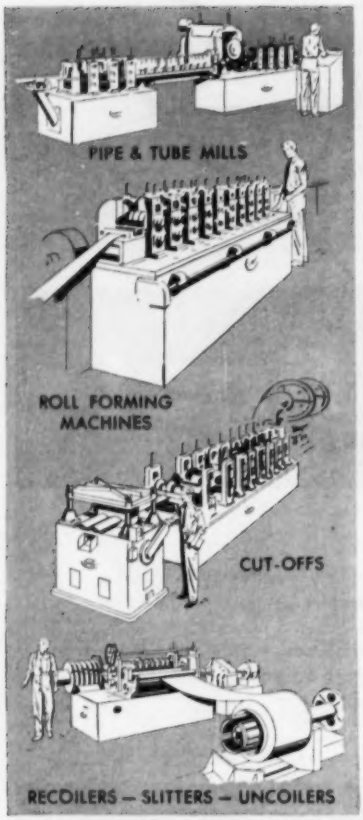

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Easy-to-Work Printing Process

A new relief printing process called Helio-Print can be carried out in any office without skilled printers, according to the manufacturers.

The procedure is simple: After the original has been photographed, a Helio plate is moistened with an agent to make it light-sensitive. Then the photo-negative is copied onto the plate. The plate is next wiped with a relief development agent: Wherever light has fallen on the plate during the copying process, the Helio layer has hardened while all other spots have remained soft and can be removed. As soon as it is dry, the plate is ready for printing.

Helio plates are inexpensive and can be used for 1-2 million reprints. Maximum size is 20 x 27.5 cm. A printing machine offered by the same firm can produce up to 100 prints per hour. **Roto-Werke A.G., Koenigslutter, Germany.**

Plastic-Coated Steel

Commercial production has now begun of a new product called Stelvetite, which is made of sheet steel bonded to polyvinyl chloride plastic. In Stelvetite, the plastic is applied in the form of finished sheet coil with the coating .035-cm. thick. It can be of any color, can take a range of embossings, and is said to be scratch-proof and resistant to acids, oils, and weather. **John Summers & Sons Ltd., Hawarden Bridge Steelworks, Shotton, nr. Chester, England.**

In Brief: Color-sorting of peas, ground-nuts, coffee beans, is done electronically by a machine designed by **M.J. de Goeje, Zaandam, Netherlands** . . . A narrow-aisle electric tiering truck is claimed to be the first working on a 24-volt electrical system. **Lewis-Shepard Products Inc., 125 Walnut St., Watertown 72, Mass., U.S.A.** . . . A miniature camera, the Fernauge, can peer inside tubes and pipes only 60 mm. in diameter. **Grundig Radio Werke, Fuerth, Bavaria, Germany.**

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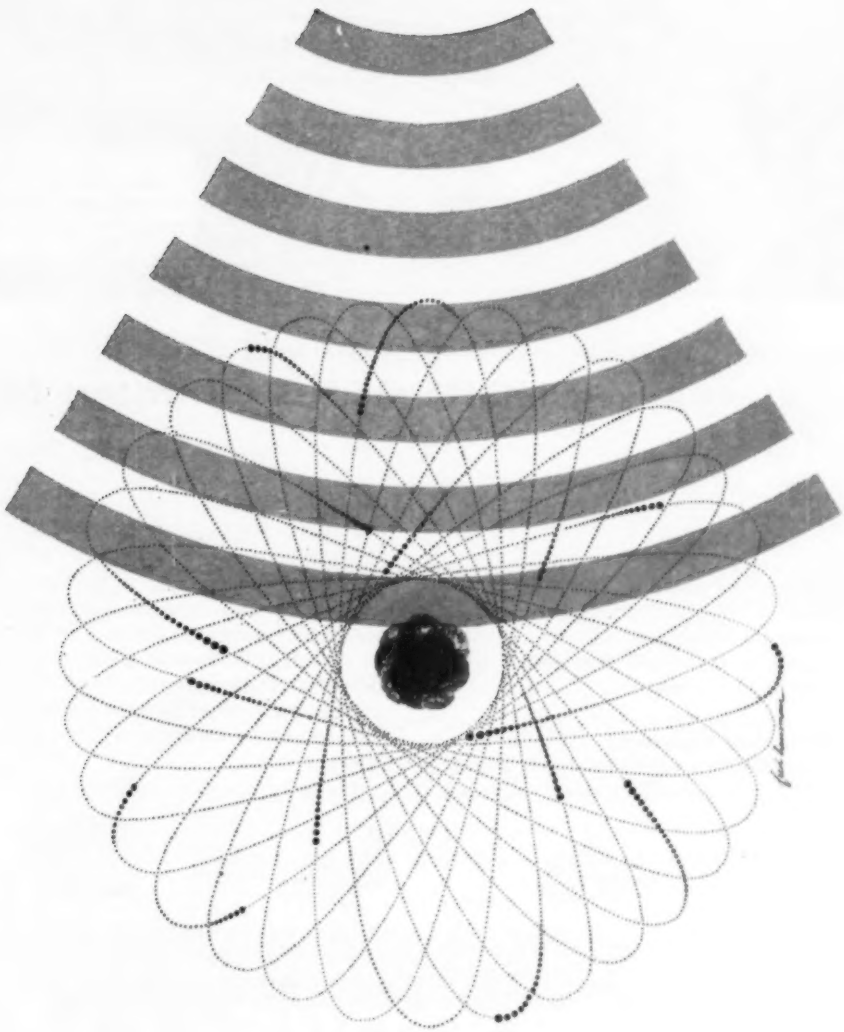

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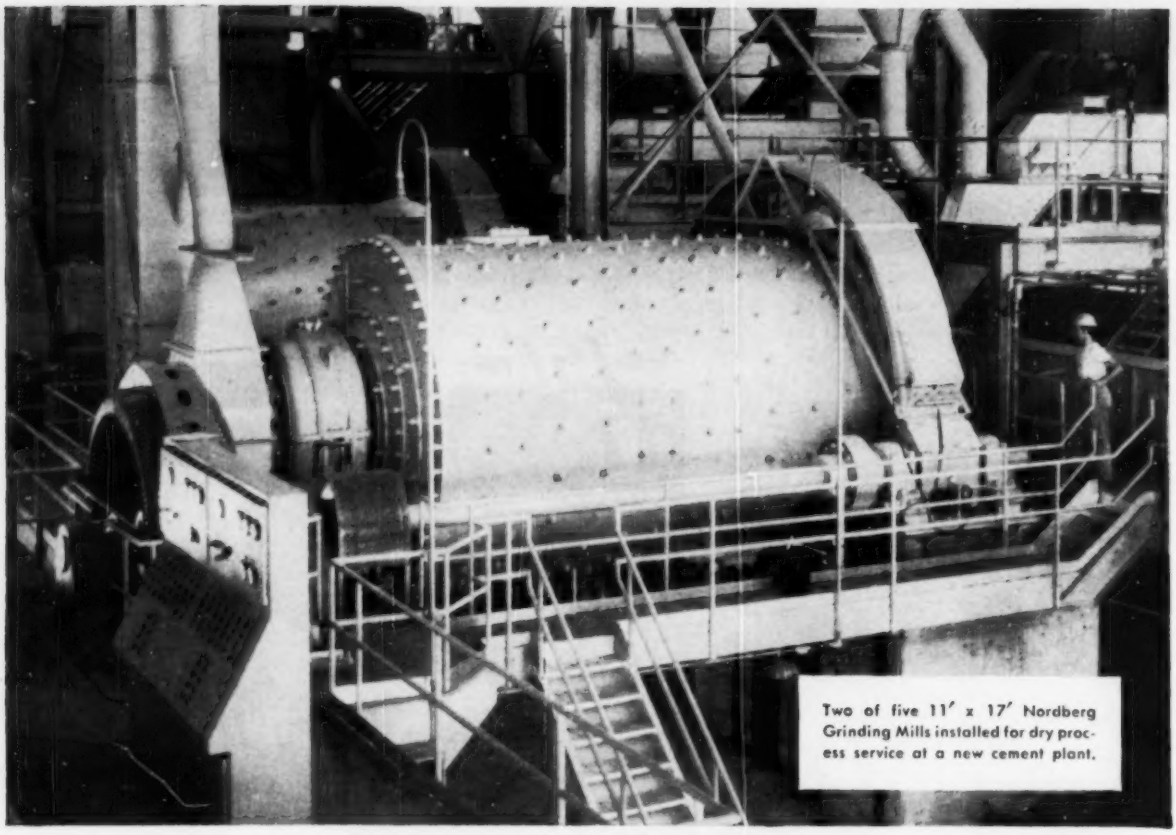

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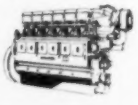

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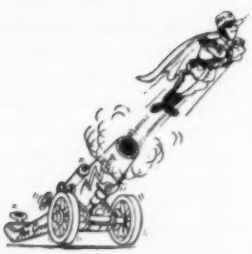

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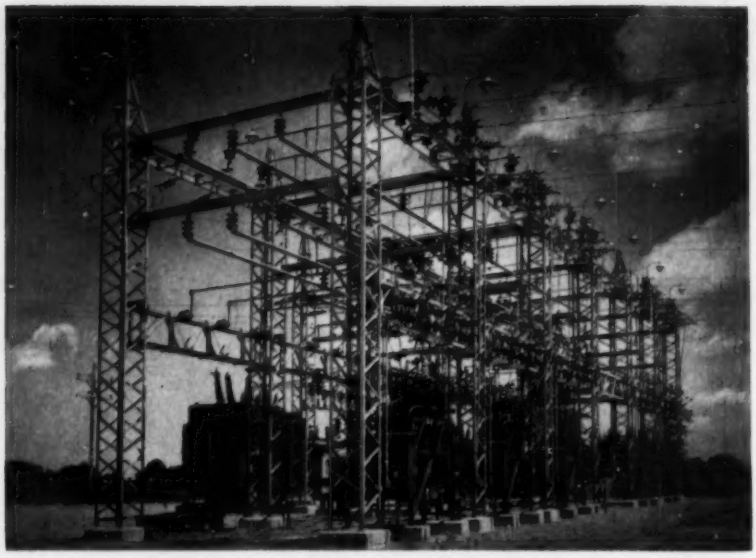


New Power from Old Sources

ATOMIC POWER offers great hope for mankind, but it is by no means the answer to all of the world's energy needs. The demand for energy not only is growing everywhere; it is as varied as the geography and culture of the earth.

Electrical energy is needed to pump millions of cubic meters of water into deserts, and to burn beacons for lonely lighthouses. A Soviet farm may need only a couple of kilowatts to keep its radio tuned to Comrade Khrushchev's pronouncements, but a small growing community will need 50,000 or 150,000 kw for home and industrial use. Electricity is needed in industrial cities, small towns, farms, mines, quarries, in the dense jungle and in the sub-zero antarctic.

Because of this diversity of need, scientists of many countries today are making a determined effort to find new sources of energy. They have come up with five unconventional sources that appear promising: geothermic energy, thermal energy of the seas, tidal, solar, and wind energy.

This month, geothermic energy steps into the spotlight with the announcement that Mexico by the end of the year will be turning some of its natural volcanic steam into power at Pathe, Hidalgo State. Aid in developing this initial 3,500-kw unit came from Italy, where natural steam has been used for 50 years. Today Italy gets a substantial part of its power from the 160 steam wells at Larderello.

Geothermic and the other four new sources are inviting because they are gifts of nature. No fuel is required. Initial cost is practically the entire cost, aside from maintenance and amortization.

The costs of plants using these new sources can only be estimated in a general way. Some of them appear to be competitive with conventional sources, and others offer special advantages in some parts of the world. Here are details of the advances being made in developing these five sources, based on studies reported on last year by a committee of the United Nations ("New Sources of Energy and Economic Development," U.N. Department of Economic and Social Affairs).

Use of natural steam or hot water for the production of power is an industrial reality in Italy, and seems destined for use in several other countries. The Japanese have had a 30-kw pilot plant for some time, and have plans for a 3,000-kw station. The Katanga mining area in the Belgian Congo has a 275-kw unit; a 37,500-kw station is reported under construction in New Zealand; and sizable plants are being studied for Chile and for the California coast of the U.S.A.

Geothermic use offers the simplest method of tapping an energy source. Wells are drilled down to steam or hot water channels, and valves are fitted at the top of these wells. In the earliest Italian installations the steam was fed directly to a turbine, and then exhausted to the air.

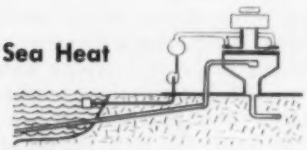
These first plants made no effort to use the chemical by-products in the steam—boric acid, ammonia, sulfur—as was later done in Italy and is planned for Mexico.

Plants built more recently at Larderello are larger, have greater efficiency in steam utilization, and recover chemicals from the steam. Generators have capacities of from 12,500 to 25,000 kw, as compared with the 3,500 kw in the first units.

In these larger units the natural steam is not applied directly to turbines. Heat exchangers and a closed circuit of pure steam is used. This has meant a far more complex plant, including large boilers, vacuum pumps, water circulating pumps, and water coolers. But far better steam economy is achieved.

Geothermic energy has compelling

appeal where the resources are available. The steam is free, and the initial cost is competitive—about $170 to $230 per kilowatt. (Compare it with conventional thermal power's $125 to $150 per kw; hydro-power's $250 to $350; atomic's $350 to $600 or more.) Geothermic's special problems are control of the gases present, and the use of metals that can withstand these gases.



Another inviting potential source of energy lies in the heat of the sea—more specifically in the temperature difference between surface and deep waters in the tropics. France began studies of thermal energy of the seas at Abidjan, Ivory Coast, about 30 years ago, and this work has been intensified recently.

The development employs the principle that heat can be converted into energy whenever reservoirs of different temperatures are near each other. In certain parts of the world the sun-warmed surface of the ocean is several degrees higher than a layer of water just below. Energy is produced from this condition through an evaporator, turbine, and a condenser.

The process used by French scientists allows the warm salt water to enter a low-pressure vessel. A vacuum is created with an air gas extractor, and part of the warm water flashes into vapor. The steam moves an extremely low-pressure turbine while it is sucked into a condenser, which is cooled by water pumped from a lower level of the sea.

Using thermal energy of the seas is best combined with water desalting operations. Warm salt water is evaporated into steam, then condensed into usable fresh water.

No plant using thermal energy of the seas now is in operation, but experts point to encouraging conditions in many tropical and semi-tropical areas. Besides the work in Africa, studies have gone ahead off Cuba and on the U. S. Pacific coast.

Thermal energy of the seas has captured scientific imaginations because of the huge bodies of water—and therefore the huge quantities of heat—that would be available. Theoretically, plants of any size could be built, but only the largest plants appear to be economically sound.

Initial cost will be high. The Abidjan 7,000-kw plant probably will cost more than $1000 per kw. Bigger plants will sharply reduce this unit cost, but the future of this type of energy recovery may lie in combination projects that also serve to make fresh water, and possibly even to harvest fish for food.

The other three unconventional sources of energy—tidal, solar and wind—are by their nature intermittent. Tidal energy, though discontinuous, has a regular and predictable pattern. Tides occur twice a day on the Atlantic coasts, and in some parts of Asia, once a day.

Exploitation of tidal energy is under study in France, the Soviet Union, England, New Zealand and the U.S.A. France has been making encouraging progress in its tidal project at the mouth of the Rance River (IMD, Aug. '56, p 14). A 342,000-kw station is expected to be in service by 1963, at a cost of $100-million—about $290 per kilowatt.

Converting tidal action into electric power is quite similar to generating hydroelectric power on land. The energy is inherent in the falling water. All that is required is a suitable collecting basin to hold the water at flood tide. When the tide recedes, the water is directed through sluices and moves a turbine.

New developments in this field include the search for flexibility through the use of a series of connecting basins, so that one basin generates power during the filling or flooding stage and another during the ebb, Also, French engineers at Rance have introduced a turbo-generator able to operate submerged and in both directions, during both ebb and flood tides.

The tidal plant at Rance is designed to have 38 generating units, each producing 9,000 kilowatts. Operating costs will be about 10% higher than for a comparable hydroelectric plant, because of the special difficulties involved in handling sea water.

Both the heat and the light of the sun have long been used as energy sources. Photosynthesis in plants, solar cooking, distillation of salt water, heat pumps—all use the sun's energy. Despite the amount of energy available—some 2,000 times as much as produced from fuel even in industrialized U.S.A.—exploitation is still mainly in the research stage.

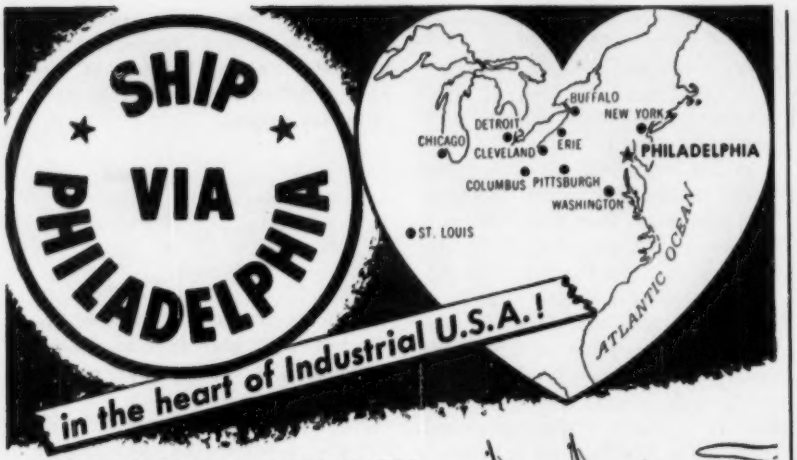
One reason is the gigantic equipment required. Solar rays reach the earth at low intensity. Estimates show that some 13 to 27 square meters of surface is required to receive solar radiation for conversion into a single kilowatt of work. A 100,000-kw generating plant would require a collector about 2½ square kilometers in size.

Despite this major handicap, research into solar energy has speeded up in the last two or three years. The impetus has come from the need of the non-industrial countries of the world, and from advances in materials and techniques.

Until recently solar collectors were made of glass, which is heavy, fragile, and costly. New research has pointed to plastics as an alternative material. Plastics are light, inexpensive, can be cast into any shape required. A new process puts thin metal coatings on plastics, providing a reflector of high efficiency that weathers well.

The future of solar energy is in the hands of scientists. Homes are heating their water and space with the sun, a number of successful solar cookers have been developed, heat pumps are both heating and cooling houses. But the sun is not being used directly to generate electricity, and may not be for some years.

Experts say the best long-range hope in this field is in using the sun's light, rather than its heat. Half of the sun's energy comes to the earth as visible light. Laboratory apparatus has shown that light



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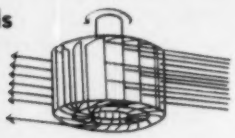
Winds



One of the earliest sources of energy, wind now is being given serious consideration as a modern auxiliary power source. In past times wind energy was converted directly into mechanical energy, for grinding grain or pumping water. Now it is being converted into electricity. Electric windmills are in use or planned in many countries—in Europe, North America, South Africa, and Australia.

Extensive studies have been made of wind patterns, and of the efficiency of various turbines and propellors for using the wind. The energy obtainable from wind depends basically on its speed and the size and shape of the rotor.

Wind energy is available in many areas of the world. But even the windiest spots have calm spells, so wind energy normally must be considered as a supplement.

This does not weaken its value. In many windy areas of the world hydro-power is unattainable, coal or petroleum very expensive. The possibility of an electric system that can be supplied partially by imported fuel and partially by wind becomes inviting.

A key advantage of wind machines is that they can vary widely in size, from a fraction of a kilowatt to several thousand kilowatts. Machines now in use often are classified into three groups:

—**Small machines, up to 5 kw,** used in various countries for small-farm power, battery charging.

—**Medium plants, generating 5 to 80 kw,** supplying electricity for farms in parts of Europe.

—**Large plants, 100 to 200 kw,** in Denmark and England, feeding existing electric systems.

The costs of plants using wind energy depend on many factors, including the speed and constancy of the winds. Generally the bigger the plant, the lower the cost. Initial investment for large plants ranges from $140 to $280 a kilowatt; for medium plants, $280 to $400; for small plants $400 to $550.●

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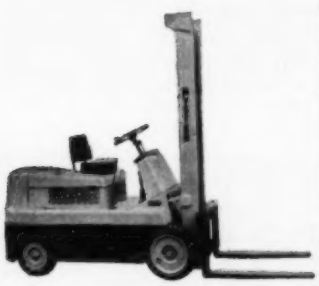

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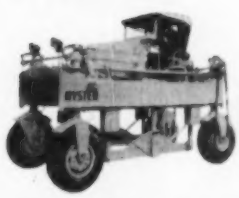

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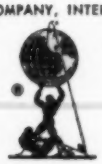

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YOU CAN DEPEND ON DOW

Businessmen are switching to air cargo—for routine shipments as well as emergencies. But it may require a fresh look at distribution policy to see how . . .

Air Cargo Can Cut Shipping Costs

NEXT MONTH jet airliners roar into regular service across the Atlantic. The businessman who flies from Paris to New York in a few hours may wonder: Can I dispatch my goods this way too?

If this accelerated service causes more businessmen to consider airfreight for their regular shipments, the airlines will be happy. They are hungry, looking for new business—and the arrival of the jets will increase their determination to develop international airfreight.

Air cargo is no longer exotic. The airlines may still whisk wild animals from tropic homes to temperate zoos. They still perform mercy missions, rushing drugs to the scene of an epidemic. But errands like these could never form the basis for a stable business operation. So the freight-minded airlines have solicited the more routine traffic which can mean reliable—and hence more profitable—operations.

For example, an analysis of KLM Royal Dutch Airlines' current business shows vehicles and machinery accounting for 35% of total air cargo volume. Textiles rank second at 8%, and chemicals come third with 7%.

To get this kind of business, the airfreight carriers had to show hard proof that they could compete in cost with sea-borne shipping. To offset the appeal of basically cheaper ship rates, the airlines have emphasized their compensating advantages in other freight costs: lower insurance, less pilferage, reduced damage, less interest on inventory in transit. This type of analysis has enabled the airlines to snare increasing traffic away from the steamship lines.

Volume revenue now comes from products as diverse as:

—**Clothing,** placed right on racks, and delivered direct to the retailer ready to be sold. He can respond quickly to fashion trends, carry lower inventories.

—**Motion Picture Films.** Faster circulation enables promoters to realize a faster return on their huge capital investment, permits them to secure wider "first-run" distribution.

—**Small Airplanes.** This "kangaroo" shipment typifies the heavy machinery being moved by air; the greatest advantage comes from moving planes intact rather than crating them.

—**Household Effects.** Families can set up housekeeping soon after arrival—an important morale factor; their belongings require little packing.

1. Speed & Service

What can airfreight offer ordinary shippers? In addition to speed and special handling, the airlines schedule more frequent departures than the steamships. In contrast to heavy shipboard crating, the airlines accept goods on skids or pallets, with only a draping of protective material. Despite this cheaper packing, airfreight breakage and pilferage rates come to a small fraction of marine rates. And these factors work to keep insurance premiums very low.

Traffic patterns create opportunities for shippers located in raw-material producing areas. For example, Pan American World Airways flights from the U. S. A. go to Latin America filled to 90% of capacity but return carrying only a 40% load. To encourage fuller use of this space, Latin American exporters are offered a one-third discount on northbound flights.

Because they feel they have to outperform their long-established marine competitors in giving service, the airlines pay unusual attention to customers' wishes. This can mean accepting troublesome cargoes of whole automobiles in order to secure lucrative spare parts traffic. As one carrier explains, "You can't take the carburetors—and turn down the Cadillac."

This attentiveness shows up in the many ways the airlines have accelerated the shipping process—by developing a single international throughbill of lading; arranging interline reservations on connecting airlines; providing easy damage-claim procedures.

The airlines even get involved in market research. One airline sought the business of a U. S. manufacturer who shipped his

SHIPPING BY AIR

Airlines use case studies like these to sell international airfreight.

	55 kg. of straw goods Milan to London		50 kg. of medicine London to Mexico City	
	surface	air	surface	air
Freight charges	$25.00	$25.65	$180.00	$ 91.50
Fees & Duties	5.76	6.10	4.44	4.22
Insurance	.65	.17	300.00	114.00
Packing	3.00	3.00	—	—
Delivery charges	4.50	4.00	39.35	.40
Brokerage	—	—	8.00	8.00
Total cost	$38.91	$38.92	$531.79	$218.12
Total time	3 or 4 days	1 day	24 days	2 days

heavy product to Italy by boat. Discovering that most of the unit's weight lay in its cast-iron base, the airline found a German concern to make the base. Now the units are airfreighted to Germany for final assembly, then sent on to Italy—at a saving in time and transportation cost.

II. Cutting Costs

But while services like this and analyses (see example on previous page) compare the direct costs of transporting goods, they fail to show airfreight's effect on indirect distribution charges. It is in the area of inventory control that the airlines' great speed permits some dramatic savings.

Wallace Clark and Company, American management consultants, point out that the following costs drop when inventory levels are cut: interest on capital tied up in inventoried goods; local property taxes; insurance on inventory; storage space rental or depreciation; cost of supervision; obsolescence of inventory. Clark advises clients that these costs range from 18% to 30% of total inventory value. Thus inventory control, combined with the opportunities for extending markets and faster order-filling, helps the airlines mount a convincing argument for airfreighting any product whose value exceeds $6 per pound.

Their arguments have persuaded several companies to eliminate branch warehouses entirely in favor of shipping by air. But more often, airfreight salesmen run into trouble because businessmen and their accountants who may have a clear idea of production costs do not know their distribution costs. Expenses such as interest or taxes on inventory lie buried in general expense accounts. In their drive to demonstrate the virtues of airfreight, the carriers are helping to develop a valuable new form of cost analysis.

III. How To Fly

The mechanics of airfreight must be understood before it can be used profitably. There are three different ways to ship by airfreight: through a forwarder, directly with the airline, or by chartering a plane.

The freight forwarder (or "consolidator") offers the most convenient method—at the highest price. He delivers the goods to the airport, arranges routing and oversees any details of the shipment. He makes his profit by charging the shipper the highest rate while he receives a quantity discount from the airline. These discounts are available to all large quantity shippers, but the freight forwarder qualifies for them by combining many small consignments into one shipment heavy enough to take advantage of the airline's "breakpoints"—weights at which the airline offers a lower rate per pound.

Generally it pays to use a forwarder for light shipments falling under the first breakpoint (usually set at 100 pounds). But consider accumulating shipments if the breakpoint offers large savings—on some runs, the drop is 50% at the first breakpoint. And check on a forwarder's performance periodically. He may hold up shipments while accumulating weight. Or he may occasionally ship by a roundabout route.

Dealing directly with the airlines (or one of their sales agents) gives you greater control over shipments—plus the advantage of any breakpoints. But you have to investigate each carrier as a separate proposition. Attitudes and capabilities in regard to freight vary widely. Many carriers treat airfreight as a bothersome adjunct of the passenger business, carry it only to fill odd space unfit for passengers.

The airlines flying all cargo craft can be expected to offer more consistent service and they can accommodate bigger loads, larger dimensions than the "line aircraft" (combination passenger-freight). Even among the active freight carriers and the air-cargo airlines, it is important to learn what they individually offer as to routes, schedules, equipment.

Chartering a whole airfreighter can pay—if you are a large-scale shipper. Capacities range from about 11,300 to 13,000 kg., but you still can effect savings with a less-than-capacity load. Planes are rented on a flat-rate basis regardless of the type of cargo carried. This makes chartering particularly attractive to the shipper of a high-rate product. Freighters usually become available only on weekends—and are economical only if one ends its regularly scheduled run near your shipping point. Otherwise, the airlines impose a stiff ferrying charge to bring a cargo-liner to your airport.

IV. Down to Earth

While some shippers complain the airlines must develop a specially-designed cargo plane, most airfreight problems occur on the ground. The airlines can speed goods across the Atlantic in less than a day, then spend the same amount of time or more getting them delivered from airport to consignee. BOAC—British Overseas Airways Corporation—for one, is experimenting with exclusive trucking service in an attempt to break this bottleneck. A major roadblock looms at the Customs counter: "They think they're still in the steamship days," grumbles an airline official.

But the greatest barrier to airfreight expansion still lies in its rate structure. International carriers are bound by IATA—their own regulatory commission—as well as by national aviation boards. With each IATA member enjoying veto power, the lines indifferent to freight volume have prevented the freight-minded carriers from cutting rates.

The jet transports will revolutionize this situation. All international airlines have rushed to order this high-speed equipment to spur the passenger traffic—but the jets will increase cargo capacity as well. Even when carrying a maximum passenger load, the jets will have space for 3,600 to 4,500 kg. of freight. And their greater speed means many more round-trips, further increasing freight potential. Finally, the jets will make obsolete propeller craft for the passenger trade and most observers are betting that the old piston-engine equipment will find its way into the freight fleets.

This suddenly expanding capacity will exert an irresistible pressure on all the lines to slash freight rates—deeply. It may suddenly make sense to ship your product by air. ●

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CURRENT RESULTS

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Runout was improved .0020"

GEAR "C"

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GEAR "E"

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Gear	No. Teeth	Pitch Dia.	Rockwell "C"	Stock Removed	TIME	
					Honing	Floor to Floor
"A" INTERNAL	83	5.7832	58-63	.0015	40 sec.	70 sec.
"B" PLANET PINION	15	.790	56	.0005	27 sec.	31 sec.
"C" REAR SUN GEAR	45	2.3726	54	.0006	30 sec.	34 sec.
"D" REAR SUN GEAR	45	2.508	58	.001	24 sec.	30 sec.
"E" SPUR GEAR	46	6.000	60	.004		3 min. 25 sec.

NOTE: Hone Life, Gear "B"—6000 to 8500 pieces
Gear "C"—3000 to 4000 pieces

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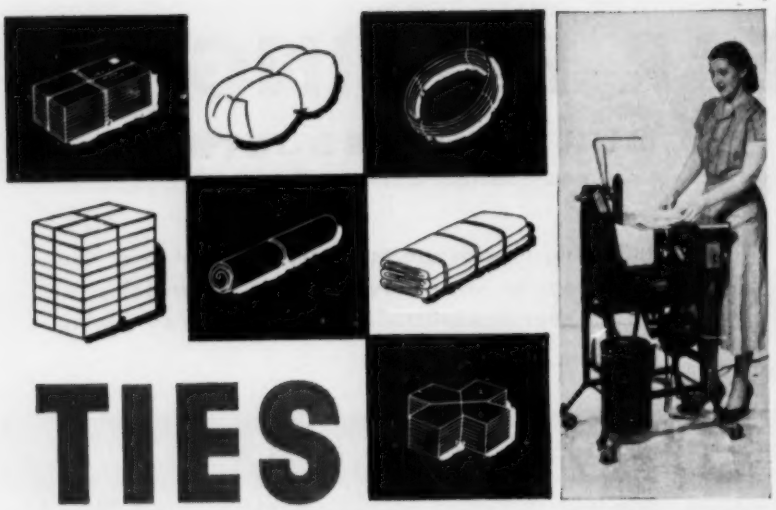

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In Marketing

CHICAGO BOOMS as the opening of the St. Lawrence Seaway next year promises a floodtide of new business. And the city is receiving a flood of new residents like:

—Addo, Swedish office machine firm, who moved its U. S. distribution center from suburban New York to suburban Chicago.

—The French jeweler who plans to use Chicago's experienced direct mail agencies as an entree to untapped rural and small-town markets. (*Printers' Ink, Aug.* 15, *p* 21)

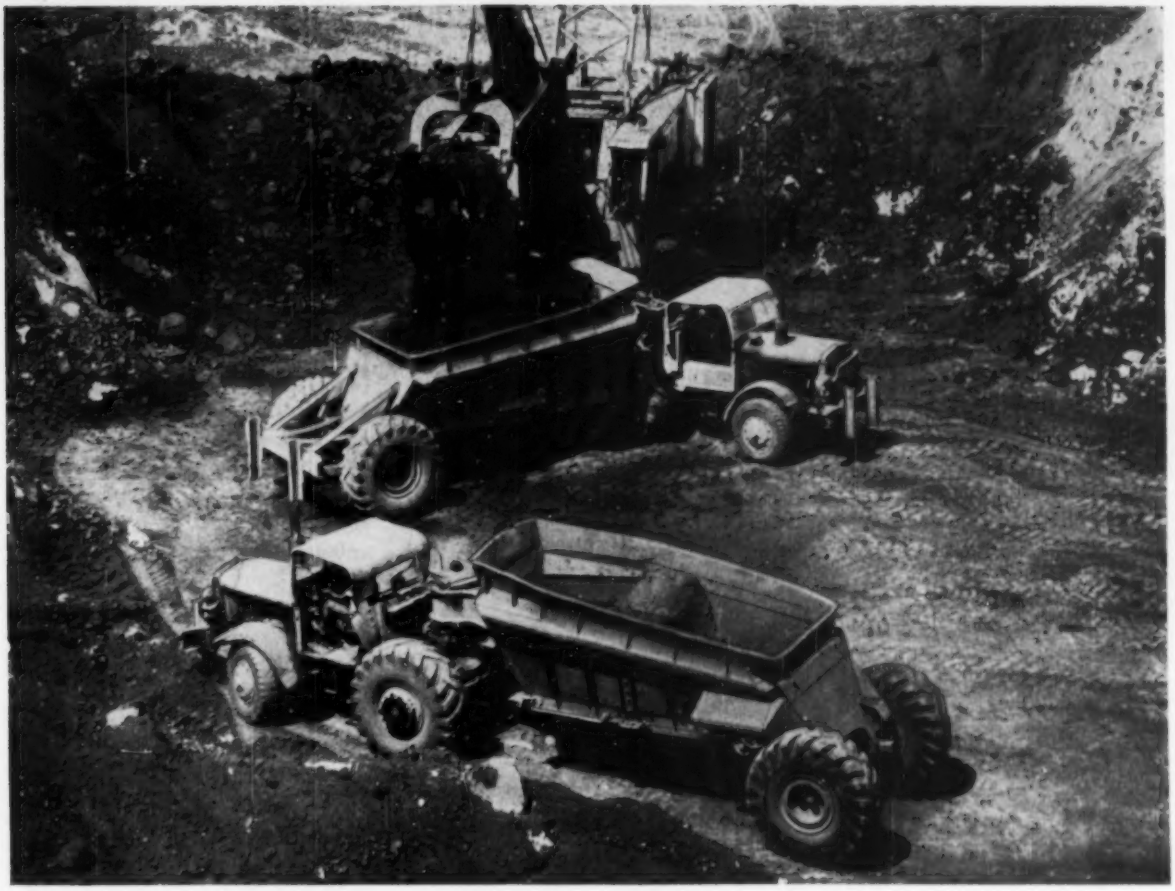
COMPANY NEWSREEL helps General Electric Co. maintain contact with thousands of salesmen in its Apparatus Division. Called a "Salesreel", the film keeps the far-flung selling force informed about developments in its 28 diverse product lines. The Salesreel supplies current news on new products, facilities and sales techniques. Sales managers find the film ideal for demonstrations. (*Sales Management, Aug.* 15, *p* 84)

SMELLS SELL for advertisers who use scented inks for their newspaper ads. The Fragrance Process Co. of New York has concocted aromas suggesting strawberries, pine needles, new cars, even hospitals. (*Sales Management, Aug.* 1, *p* 80)

DIRECT MAIL helped 3 Suisses, a Belgian knitting-wool manufacturer, vault from 3% to 40% of the domestic market in ten years. The company decided direct mail offered the best approach to Belgium's knitters—80% of all women between 18 and 70. Then it discovered no one had a reliable mailing list for the ladies.

To develop a strong list, the company ran a blanket mailing, offering premiums like knitting needles or patterns. Gradually, the list was graded according to frequency of purchases. Now mailings are directed at a select list of 1,500,000 names, produce a flood of 12,000 orders a day.

Copy is designed to convey a "guilt feeling" to the reader if she doesn't knit. "It's like the American approach to having B.O.," says the company's ad manager. (*Printer's Ink, July* 4, *p* 61)



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For helpful facts and figures on how Euclid equipment — rear-dumps, bottom-dumps, scrapers and crawler tractors — can cut costs on your mine, quarry or construction jobs, contact the Euclid dealer in your area or write:

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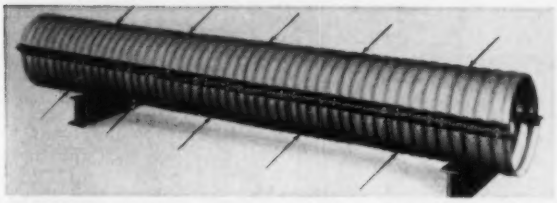
REPUBLIC DRAINAGE PRODUCTS

to help solve your drainage problems

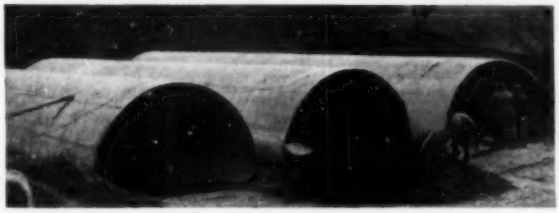


NESTABLE PIPE. Strong, durable, safe, and efficient. Lightweight nestable sections provide ease of handling, transporting, and erecting. Easy and fast to bolt together—save time and labor. Uniformly galvanized on both sides to resist corrosion. From 8 through 84 inches (20.3 through 213.4 cm.) in diameter.

NESTABLE PIPE-ARCH. Designed to provide effective drainage in locations where headroom is limited. It produces a low, wide waterway for fast runoff to keep water level down, and to reduce ponding to a minimum. Has all the installation, handling, and economical advantages of Republic Nestable Pipe.

SECTIONAL PLATE PIPE. The ideal material for large drainage structures. Made of rust-resisting galvanized Republic Copper Steel plates. Corrugations are 6 inches (15.2 cm.) from crest to crest, 2 inches (5.1 cm.) in depth. Plates are easy to assemble and bolt together with unskilled labor. Plain, skewed, or sloped ends.

SECTIONAL PLATE ARCHES. Attractive and durable small bridges can be designed easily and erected quickly with the same type of plate and bolt construction as used in Sectional Plate Pipe. A wide range of span and rise sizes can be fabricated to meet field conditions. Ends may be plain, skewed, or sloped.



SECTIONAL PLATE PIPE-ARCH. Similar in design to Nestable Pipe-Arch, but erected by bolting together corrugated plates to form large drainage structures for use where headroom is low or fill must be held to a minimum. Will handle a large volume of water with rapid runoff. Easy to handle, transport, and erect.

ASPHALT COATED DRAINAGE STRUCTURES. Recommended for use where corrosion is severe. Strong, flexible, galvanized steel is protected inside and out with a nonpeeling coating of asphalt that will not chip in cold weather or lose its stability on hottest days. Structures can also be produced from asbestos zinc-clad sheets, and asphalt coated for maximum corrosion-resistance.

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Fast stacking in storage areas

SOLUTION:

Yale Industrial Lift Trucks

In the Far East or Near East—or throughout the western world—Yale Industrial Lift Trucks are busily engaged in stacking goods in warehouses, moving materials and products, easing men of backbreaking tasks. Yale Trucks are available in a full range of capacities and with a wide selection of attachments for handling all types of materials. With these trucks, you can speed goods to market, assure your business more profits and cut handling costs up to 50%.

All Yale Petrol, Electric, Diesel and Hand Lift Trucks are available in currencies of the Free World. All are built to the same high quality standards, no matter where you buy them. Let your Yale Sales and Service Representative help you select the Yale Truck best suited to your requirements.

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INDUSTRIAL LIFT TRUCKS

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YOU

Management Reading

Running a Far-flung Empire

Managing Geographically Decentralized Companies analyzes the organizational and managerial experiences of a number of multi-plant, decentralized enterprises. The key problems that arise under such operations are identified and discussed. 185 pages, $3.50. (Division of Research, Harvard Business School, Soldiers Field, Boston 63, Massachusetts.)

Selling Shares to Employees

The Challenge of Employee Shareholding—written by the editor of the British publication "Business"—analyzes these employee incentive schemes as they exist in Britain and the U.S.A., and offers summaries of some of the more interesting plans. 200 pages, 18s. or $2.52. (B. T. Batsford Ltd., 4 Fitzhardinge Street, Portman Square, London W1, England.)

A Guide on Standard Costs

Standard Costs: How They Serve Modern Management will serve as a practical working tool in setting up a standard cost program: how standard costs are developed and used, and what results they provide. 515 pages, $12.50. (Parker Publishing Co., Inc., 70 Fifth Avenue, New York 11, N. Y.)

Bulletins from Industry

Bulletin T1-123 describes the new Swathmaster dispensing unit for aerial crop dusting and spraying. (Transland Aircraft, 2600 W. 247th Street, Torrance, California) . . . The technique of value analysis—using a handy analysis form—will help you control the costs of maintaining steel inventory. (United States Steel Export Co., 1 Church Street, New York 7, N. Y.) . . . How To Save Time and Money With Assembly Line Shipment Addressing tells how shipment addressing costs can be cut without investing in expensive equipment. (Weber Marking Systems, 215 E. Prospect Avenue, Mount Prospect, Illinois.)

Foreign Investment

Yugoslavia, Economic Guide covers this nation's industry, mining, agriculture, forestry, transport, building, commerce, banking and foreign trade. 300 pages. (Privredni Pregled, Belgrad, Yugoslavia) . . . Investing In Panama is a summary of this country's economy, opportunities for development, finance, tariff and trade controls, and taxation. (Area Development Dept., American & Foreign Power Co., Inc., 100 Church Street, New York 7, N. Y.) . . . An illustrated brochure will tell you all about investment opportunities in Italy. (Confederazione Generale dell' Industria Italiana, Piazza Venezia 11, Rome, Italy) . . . Booklet describes the advantages which make the Kempen area of Belgium—located in the center of the Benelux economic union—an exceptionally favorable site for industrial development. (Conseil Economique de la Campine, Grote Markt, Turnhout, Belgium.)

YOU

Personal Affairs

Advice for the Desk-Bound Businessman

"Our counseling is 75% a discussion of living habits," comments the director of Life Extension Foundation (LEF), a U.S. organization of physicians interested in problems of executive health. In an interview with *Purchasing Week*, LEF presents some sound counsel for the business executive over 40 years old who spends most of his time at a desk:

On exercise: The need is to give the body enough exercise to keep it functioning at its best. A man cannot get too much mild exercise. LEF urges everyone to walk at least 20 minutes, three times a day—but walking up stairs or over rough terrain is discouraged. As for violent sports, LEF advises a man to "act his age."

On job frustrations: No job is perfect. An executive cannot do only what he wants to do when he wants to do it. The big thing is to accept small annoyances as part of the job; resentment upsets people. There is no harm in an occasional, spontaneous "blow-up" that just happens. But when a person does it too often, he ought to be halted.

On the weight problem: Many people have an optimum weight a little above their so-called "normal" weight. If they try to get down and hold their weight to the absolute level, they are fighting all the time. There is no justification for a man being miserable for a small differential in weight. For the person whose weight is out of hand, LEF urges him to curtail fats first—butter, cream, meat fats, etc. The only way to control weight is to control the intake of food.

On alcohol: Alcohol definitely interferes with the efficiency of mental operation. And that is why LEF physicians strongly discourage cocktails before lunch (beer, however, is not in the same category). The best advice for most people: Have that drink at the end of the day, at home. Alcohol is relaxing. One drink is good medicine. But LEF never prescribes that second drink. After the first, a man is on his own.

On retirement: Do not worry about the man who is going to retire—if he has his health and enough money for his regular needs. Let the person alone, and he will take care of his own psychological adjustment. You cannot tell a person, "Now you have got to have a hobby." It just does not work that way.

Now on the Market

Replicas of a 1903-model automobile, The Surrey, now being manufactured by Dyer Products Co., Canton, Ohio, U.S.A., meet all highway standards. There is a tiller instead of a steering wheel, polished brass headlights and wooden-spoke wheels. Price, fully assembled, is $1,695; in "knocked-down" assembly form, $895. . . . **Transistorized portable record player** developed in Britain, small enough to fit into a coat pocket, plays standard long-playing records. It is available from Camp Bird Group, 39 Dover St., London W1. . . . **If there is a budding engineer in your family,** he may be interested in a construction kit with bearings, pulleys, linkages, etc., for building drive mechanisms using air, water, or steam power. There is also a similar kit for "young electricians." Both come from Kosmos Frank'sche Verlagshandlung, Pfizerstrasse 5, Stuttgart, West Germany.

Why is the field clothed in **black?**

Many people have been puzzled to see cultivated fields completely covered with black film made from Union Carbide polyethylene resins. Through small cuts in the film, plants may be seen growing. Or sometimes the plants are covered with plastic tents. This is just one of the reasons why you'll be seeing much more polyethylene film in agriculture, because results so far have been remarkable.

Different colored film is used for different purposes and for different

the ground, and helps ripen crops ten days to two weeks early. Aluminum color reflects the sun and keeps the soil cooler in mid-summer. Other pigments keep out harmful red and infra-red and let in the growth-stimulating green, blue and ultra-violet rays.

IN ANY COLOR, film made from UNION CARBIDE polyethylene resins keeps down weeds, holds moisture and fertility in the soil, helps combat many plant diseases and blights, keeps fruit clean, helps give a greater yield of higher quality. It also helps promote plant growth by keeping the soil loose and does not interfere with normal harvesting methods, for rubber tires will not harm it. Users report that polyethylene film returns its cost several times over the first year, with every indication that the same polyethylene film can be re-used for three to five years.

FREE BOOKLET IMD-10 describing the many uses of film made from UNION CARBIDE polyethylene resins in agriculture, including mulching, silage protection, lining ponds, irrigation ditches, and green house construction will be sent you on request. This booklet also includes information on other UNION CARBIDE products which serve agriculture; CRAG Agricultural Chemicals and EVEREADY Garden Products. Write to UNION CARBIDE INTERNATIONAL COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y., U. S. A.. Cable Address: UNICARBIDE, New York.

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UNION CARBIDE

Two hydraulic leveling cylinders automatically compensate for grades up to 37%; keep John Deere Model 55-H combines driving with full efficiency. Other power-assisted components: steering; cutting-platform elevation. Quality-built by John Deere, of Moline, Ill., these machines easily absorb the punishment of hillside combining; stay on the job to deliver the crop. One reason: vital hydraulic lines are of strong, leakproof Bundyweld Tubing.

Slope-walking combines on telescoping legs rely on lifelines of Bundy Tubing

THESE John Deere combines walk Western hills with the surefootedness of mountain goats, because telescoping hydraulic cylinders automatically level the machines. When ripening crops call for action, these combines need built-in ruggedness. So to help insure harvest-time dependability, John Deere, like so many leading manufacturers, uses lifelines of Bundyweld® Tubing.

Bundyweld is *extra-dependable* because it's made by an exclusive process (below) that gives it unique physical properties. So it has become the safety standard of the refrigeration and automotive industries. ***Bundyweld is used on 95% of U.S.-made cars for fuel, oil and hydraulic lines, in an average of 20 applications.***

Industrial designers everywhere know that Bundy® offers them ultra-reliable small-diameter tubing with a bonus: specialized engineering aid. Bundyweld provides solutions to new mechanical and fluid-transmission problems almost daily. Where high strength, ductility, lightness and low cost are important, there is no *real* substitute for Bundyweld Tubing. Write us today, or cable BUNDYTUBE.

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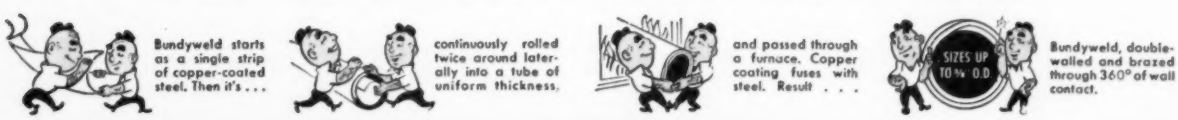
WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

WHY BUNDYWELD IS BETTER TUBING


Bundyweld starts as a single strip of copper-coated steel. Then it's . . .
continuously rolled twice around laterally into a tube of uniform thickness,
and passed through a furnace. Copper coating fuses with steel. Result . . .
SIZES UP TO ¾" O.D.
Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD® TUBING

DOUBLE-WALLED FROM A SINGLE STRIP

Sizes up to ⅜" O.D.	Lightweight
Leakproof	Machines easily
High thermal conductivity	Takes plastic coating
High bursting point	Takes plating
High endurance limit	Shock-resistant
Extra-strong	No inside bead
Ductile	Uniform I.D., O.D.